

Some Japanese Mayfly Nymphs¹.

By

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With Plates III.-XVII. and 6 text-figures.

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There have been described from Japan a number of imagoes of the mayfly, but no special references were ever given to the life-histories of those forms. The aim of the present work is to describe the nymphal stages of some Japanese mayflies. The materials consist chiefly of the collections in possession of the Ôtsu Hydrobiological Station and some others obtained by myself, comprising specimens not only from the vicinities of Kyôto and Ôtsu, but also from many other parts of Japan.

It is impossible for me at present to give any concrete accounts of their adult stages, since I am not as yet acquainted with the complete life-histories with the exception of a few species.

The classification adopted in the present work is principally after J. A. LESTAGE's system (1917 and 1921) which seems to me to be suited to the classification of the nymphs. Of the 15 genera treated in this article containing 7 new species, 10 are new to the mayfly-fauna of Japan.

In closing, I am very grateful and offer my sincere thanks to Professor T. KAWAMURA who kindly read through this manuscript and aided me with much invaluable criticism and advice. I must also heartily

¹) Contribution from the Ôtsu Hydrobiological Station and the Zoölogical Institute, Kyôto Imperial University.

thank Messrs. R. TAKAHASHI and S. ISSHIKI of Formosa for their kindness in giving me many Formosan materials collected by them.

Order: **EPHEMEROPTERA**

Synopsis of the Japanese Families¹

- a.* Mandibles generally with an external tusk-like ramus projecting forward from the mouth; abdominal tracheal gills 6 or 7 pairs, two-leaved, linear, the margin plumously fringed with respiratory filaments *Ephemeridae*.
- aa.* Mandibles without any such tusk-like ramus projecting forward as in *a*; abdominal tracheal gills generally 7 (often 5) pairs, not plumously fringed as in *a*.
 - b.* Eyes dorsal; body and legs strongly flattened dorso-ventrally; tarsal claw with lateral pectination of teeth *Heptageniidae*.
 - bb.* Eyes lateral; body-forms variable, usually cylindrical; tarsal claw smooth or toothed below *Baetidae*.

I. Family: Ephemeridae.

Key to the Japanese genera of Ephemeridae².

- a.* Mandibular tusk very long, visible from above, with a conspicuous frontal prominence bifid at tip; 7 pairs of gills present on abdominal segments 1-7 1. *Ephemera*.
- aa.* Mandibular tusk short, not visible from above; frontal prominence inconspicuous; 6 pairs of gills present on abdominal segments 2-7. 2. *Potamanthus*.

1) In order to prepare the keys inserted in the following pages, I have freely used NEEDHAM's key to the North American mayfly nymphs (1905, pp. 26—28), referring to EATON's keys in his Revisional Monographs (1883—1888).

2) Y. TAKAHASHI (1924, p. 379) described from Japan the imago of *Polymitarsis higae* as a new species, but I have never found the nymph of this genus among our materials.

I. Genus: Ephemera LINNÉ (1746)

EATON, Rev. Monogr., pp. 58-59; ESBEN-PETERSEN (1910), pp. 72-73; LESTAGE (1921), pp. 182-185.

***Ephemera* (?) *japonica* McLACHLAN (1875)¹**

(Plate III., Figs. 1, 1a-1n)

Description :—Body elongated and rather cylindrical (Fig. 1). Head narrowed anteriorly, with a conspicuous prominence bifid at tip, and brown in colour. Pronotum somewhat arched above and with a pair of symmetrical linear blackish-brown marks. Antennae (Fig. 1b) long, at the joints of the basal halves provided with long hairs, while the slender apical halves are beset with very short minute hairs; the basal two joints corpulent, the second of which is provided with a bush of hair. Mouth-parts are hairy as shown in Figs. 1c, 1d, 1e, 1f, 1g, 1h and 1i. Mandibles with a large, long, brown, tusk-like ramus, curved outwards, of about $\frac{1}{2}$ the length of the antennae and visible from above. Lacinia of maxilla small, narrowed toward the tip and armed with a few spines at its terminal end; maxillary palpus long and slender, 3-jointed and nearly 3 times as long as lacinia. Labial palpus 2-jointed, the basal joint flattened and the second widened distally, the latter with the outer surface pilose and the distal end spinous; glossae and paraglossae large and oval in shape, the outer margins of the latter closely fringed with hairs. Median piece of hypopharynx nearly oval and lateral pieces rounded.

Legs strong, flattened, twisted, well adapted for burrowing; femur, tibia and tarsus remarkably fringed with stiff hairs on the edges, and uniformly brownish in colour (Figs. 1j, 1k, 1l); tarsal claw pointed, without any teeth.

Abdomen cylindrical, not rapidly tapering backwards; each segment

¹) EATON, Rev. Monogr., pp. 74-75 (McLACHLAN, 1875, *Trans. Entom. Soc. London*) [Imago].

brownish on the dorsum, and the ventral pale yellowish, with a pair of symmetrical linear deep-brown markings diverging posteriorly as illustrated in Fig. 1a. Gills present on the abdominal segments from the 1st to the 7th; of the 1st segment small, linear, two-leaved, without any filaments (Fig. 1m), but those from the 2nd to the 7th large, flattened, linear, two-leaved, and densely fringed plumously with many long purple respiratory filaments (Fig. 1n). All gills are directed backwards and come in contact with their tips on the median line of the abdominal dorsum (Fig. 1). Caudal setæ nearly $\frac{1}{2}$ as long as the body, thinly fringed on both sides (Fig. 1).

Size: Length of body in well-grown nymphs..... 18-19 mm.

Length of median caudal seta 8.5-9 mm.

Length of outer caudal setæ..... 8 mm.

Remarks: There are some reasons to believe that this nymph corresponds to *E. japonica* McLACHLAN, the imago of which is already known in Japan¹.

Localities: Lake Towada, Prov. of Rikuchû (Northern Japan); Prov. of Shinano (Central Japan).

Notes: One specimen was captured by Mr. M. MOCHIZUKI in Dec., 1917, at Kumazawa-tôge in the northern part of the Prov. of Shinano; another was taken by myself in the middle of July, 1925, in a small creek running into Lake Towada, under a small stone covered by mosses. 8 more specimens were obtained in Aug., 1926, from Chigi-zawa or a branch of the Tenryû River, in southern Shinano, where it is said to have lived burrowing in the sandy bed of that stream.

1) There are three Japanese species of *Ephemera* described from imago specimens, namely: *E. japonica*, *E. orientalis* McLACH. (1875) and *E. strigata* EATON [1892, *Entom. M. M.*, XXVIII, p. 302]. Recently J. A. LESTAGE has treated 4 Formosan species including *E. japonica* in his "Tableau des *Ephemera* orientales" (1927, pp. 95-99), namely: *E. formosana* ULMER (1920), *E. Sauteri* ULMER (1912) and *E. supposita* EATON (1883). *E. orientalis* and *E. strigata* are not treated in this key.

2. Genus: **Potamanthus** PICTET (1843-'45)

Potamanthus luteus LINNÉ (1764)

(Plate IV., Figs. 2, 2a-2i).

VAYSSIÈRE (1882), p. 42, fig. 8; EATON, Rev. Monogr., p. 79, Pl. XXXI;

LESTAGE (1917), p. 261, Fig. 9, a-h, (1921), p. 193, Fig. 48, a-h.

Description: Body elongated and cylindrical (Fig. 2). Pronotum broad, with rounded lateral margins, and yellowish green in colour. Abdomen pale yellowish, with irregular brown markings. Wing-cases grayish brown and marked with blackish dots. Antennae short and slender, minutely setaceous (Fig. 2a).

Labrum (Fig. 2b) nearly quadrangular in shape, strigose externally. Mandibles (Fig. 2c, 2d) armed with a single large tubercle on the outer side, being invisible from above or often only visible at its tip; canine well-developed, the outer surface bearing stiff hairs and small spines. Lacinia of maxilla (Fig. 2e) fringed with lines of dense hairs and with 2 large spines at the distal end; maxillary palpus 3-jointed and about twice as long as lacinia (Fig. 2e). Labium (Fig. 2f), palpus 3-jointed and pilose, glossae very small, paraglossae large and semi-circular. Median piece of hypopharynx obcordate, lateral pieces oblong-ovate and pilose externally (Fig. 2g).

Legs comparatively robust and pale yellowish in colour; internal edge of each segment armed with stiff hairs and minute denticles, but external edge with hairs only; distal end of the tarsus provided with bushes of hairs (Fig. 2h); tarsal claw smooth.

Gills present on the abdominal segments from the 2nd to the 7th, their shape similar to those in *Ephemera* (Fig. 2i).

Caudal setae about $\frac{2}{3}$ as long as body¹ and fringed with long hairs on both sides (Fig. 2).

Size: Length of body 9-10 mm.

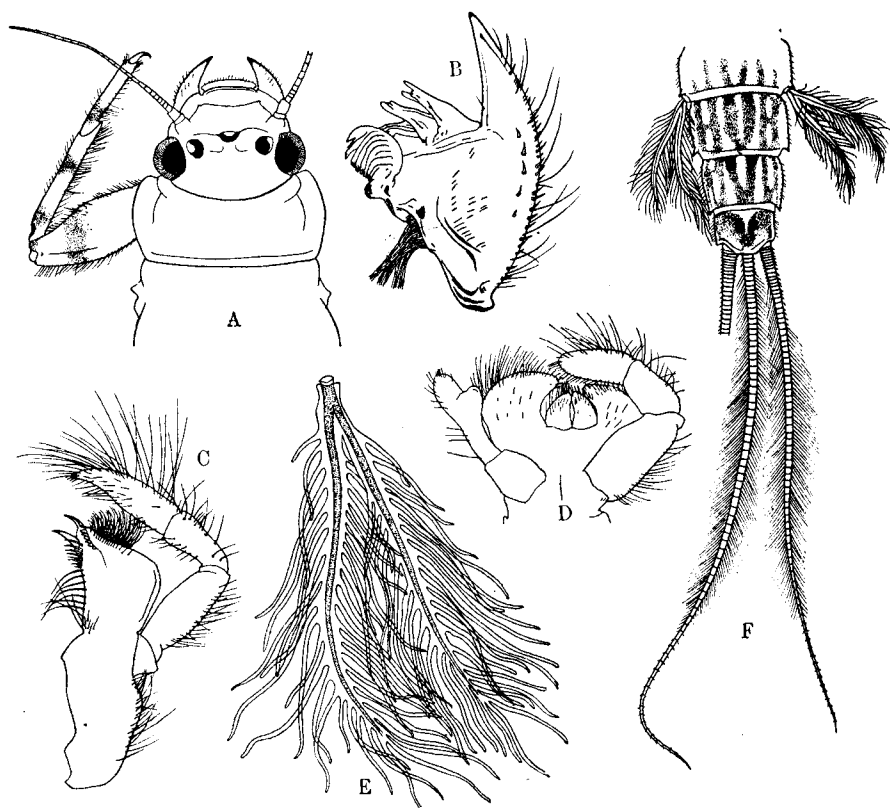
1) Somewhat longer than in those described by European authors.

Length of median seta 7-7.3 mm.

Length of outer setae 6-6.8 mm.

Localities: The Seta River, Prov. of Ômi (UÉNO, July, 1923; December, 1926 and August, 1927); the Tenryû River, at Kami-ina and Iida, Prov. of Shinano (MAKIUCHI and KITAHARA, August, 1926).

I captured this nymph for the first time in the Seta River or the natural outlet of Lake Biwa, Prov. of Ômi. This is commonly found under the stones in the bed of the rivers.



Text-figure I. ? *Potamanthus* sp.

A. Head, pronotum and left 1st leg, $\times 18$; B. mandible, $\times 26$; C. Maxilla, $\times 33$; D. Labium, $\times 33$; E. Right 6th gill lamella, $\times 26$; F. Posterior abdominal segments and caudal setae (dorsal view), $\times 18$.

? Potamanthus sp.¹

(Text-figure 1)

I found this curious nymph (only one specimen in alcohol) among the materials collected by Mr. R. TAKAHASHI in August, 1926, at Taihoku (lat. 25°N), Formosa. This nymph is closely allied to the *Potamanthus*-nymph, but its outermost canine of the mandible is conspicuously large, strong, spinous and hairy, projecting forward from the mouth and visible from above (Text-fig. 1, A and B). 6 pairs of two-leaved gills, which are similar in shape to those of *Potamanthus* found in the Kyôto region, present on abdominal segments from the 2nd to the 7th (Fig. 1, E and F). The dorsum of body is grayish-yellow brown, the ventral side of body, antennae, legs and caudal setae pale yellowish in colour.

Length of body.....9.5 mm.

Length of median caudal seta 6.5 mm.

Length of outer caudal setae 5.8 mm.

In my specimen, the right labial palpus is abnormal in shape as shown in text-figure 1, D.

II. Family: Heptageniidae*Key to the Japanese genera of Heptageniidae*

- a. Lamellæ of the foremost and hindmost gills decurved beneath the body and contact at their tips, those of the 1st segment remarkably enlarged.
 - b. Head widest toward the front; 2 caudal setae².....1. *Iron.*
 - bb. Head not widest toward the front; 3 caudal setae.....
 - 2. *Rhithrogena.*
- aa. Lamellae of the foremost and hindmost gills not as in a, small and widely separated from each other.

1) *Potamanthus formosus* EATON (*Trans. Entom. Soc. London*, 1892, p. 186) has been described from Formosa. Recently G. ULMER (1919, *Archiv f. Naturg.*, Jahrg. 85, Abt. A, Heft 11, p. 11) established a new genus *Potamanthodes* based upon this species.

2) The median seta is degenerated in the well-grown nymph, so that the insect appears to have 2 caudal setae.

- b.* 2 caudal setæ¹..... 3. *Epeorus*.
bb. 3 caudal setæ 4. *Ecdyurus*.

I. *Genus: Rhithrogena* EATON (1881)

Nymph: EATON, Rev Monogr., pp. 251-252; ESH-PETERSEN (1910), p. 80;
 LESTAGE (1921), pp. 195-197.

Rhithrogena japonica sp. nov.

(Plate IV., Figs. 3, 3a-3f; V., Figs. 3g-3n)

Description: Body strongly flattened dorso-ventrally, broadest across the front of head, then from the middle of abdomen gradually tapering toward the end (Fig. 3). Head flattened, semi-circular in the dorsal view, not widened toward the front as in *Iron* (details are described later on), with infero-lateral margins thin, flattened, sharp-edged and without fringes. Eyes dorsal. Antennae (Fig. 3a) short, usually 33 to 38-jointed and bare. Mouth-parts are shown in Figs. 3b, 3c, 3d, 3e, 3f and 3g. Labrum short and broad, nearly three times as wide as long, and its distal margin fringed with hairs. Mandible remarkably broadened distally; the outermost canine the largest and minutely serrated along its outer margin; molar of moderate size. Lacinia of maxilla armed with pectinated teeth on its outer margin; maxillary palpus 2-jointed, the proximal one widened, the terminal one clavate, gradually acute toward the tip and the external portion scabrid with numerous dense combs of spinules. Labial palpus short and stout, densely pilose distally. Of hypopharynx, median piece is nearly quadri-lateral, lateral pieces small. Pronotum about 4 times as wide as long and brownish in colour except in the median line.

Abdomen rather short, the dorsum brownish and marked with 2 dark spots on each segment, the ventral side pale yellowish and only on the last segment blackish brown (Fig. 3i). Gills present on the abdominal segments from the 1st to the 7th; lamellae thin, membranous,

1) The median seta is degenerated in the well-grown nymph as in *Iron*.

obtuse-ovoid, white (Figs. 3k, 3l, 3m, 3n); respiratory filaments purple and branched palmately; gill lamellae of the 1st segment conspicuously enlarged, decurved beneath the mesothorax, and having contact with each other at their tips (Fig. 3i, 3j); those of the 7th segment also meet beneath the last abdominal segment (Fig. 3i), but smaller and lanceolate-ovate.

Legs short and flattened (Fig. 3, 3h); tibia and tarsus slender and bare; femur large, more flattened, with setaceous external margins; tarsal claw armed with a basal lateral tooth and with from 2 to 3 lateral teeth near the tip (Fig. 3h).

3 caudal setæ, long, bare, fragile, pale, and several basal joints somewhat dark brownish.

Size: Length of body 9.5 mm.

Length of median caudal seta 11 mm.

Length of outer caudal setæ 11 mm.

Remarks: The shape of the tarsal claw in the present species reminds us of that of the nymph of the European species *Rh. ussingi*; the form of the labrum is like that of *Rh. aurantiaca*, and furthermore, the inner canines of the mandible are quite peculiar, being of a distinct tubercular shape, while a number of gill fasciculations suggests a *Rh. elongatula*-type. All these remarkable differences in important characteristics seem to be reason enough for calling the present species a new one.

Localities: Kyôto (April, 1926).

The type specimen was captured by myself on April 24, 1926, under a stone in a rapid at Kiyotaki in the western suburb of the city of Kyôto.

The other localities are: the Tenryû River, near Iida, Prov. of Shinano (UÉNO, September, 1926); the Kiso River, at Fukushima (K. MIMURA, May, 1927).

Rhithrogena sp.

Three specimens were taken by Mr. S. ISSHIKI on March 27, 1927, in a mountain torrent of Rai-sha (lat. ca. 22°30'N.), southern Formosa.

Head, thorax and abdomen purplish light brown, each abdominal segment being marked with a pair of small light spots on the brown dorsum; wing-cases dark brown or blackish. Gill lamellae large, thin and hyaline.

Size: Length of body 7-9 mm.

Length of antennae..... 2-2.5 mm.

Caudal setæ broken off and lost.

2. *Genus*: **Iron** EATON (1883)

Nymph: the literature is cited below.

Iron sp.? EATON

(*Plate V.*, *Figs. 4, 4a-4i*; *VI.*, *Figs. 4j-4n*)

Iron sp.? EATON, Rev. Monogr., p. 245, Pl. LV; NEEDHAM (1905), p. 57;
STEINMANN (1907), p. 75, Fig. 1-6; LESTAGE (1917), p. 277, Fig. 14 a-f,
(1921), pp. 197-199, Fig. 50.

Description: Body strongly flattened dorso-ventrally, widest across head and mesothorax (Fig. 4). Head flattened, nearly semicircular in dorsal view and widened toward the front; frontal margin nearly straight, infero-lateral margins thin, flattened, sharp-edged and closely fringed with fine hairs (Fig. 4a). Eyes large, on the dorso-posterior part of head; 3 ocelli. Antennae short and slender, about 26-jointed and bare (Fig. 4b). Pronotum narrow, about 4 times as wide as long, brownish in colour and with distinct G-shaped darker markings (Fig. 4). Outer margin of wing-cases blackish in the well-grown nymph. Mouth-parts are shown in Figs. 4c, 4d, 4e, 4f, 4g and 4h. Labrum nearly rectangular, somewhat widened distally, and its lateral margins hairy, while the interior margin armed with a few bristle-like spines. Outer canine of mandible armed with denticulations on the summit and its outer margin smooth and inner margin serrated; inner canine spinulated. Lacinia of maxilla armed with large curved teeth on its summit and inner margin bearing two series of stiff hairs; maxillary palpus as in *Rhithrogena*. Median piece of

hypopharynx rectangular.

Abdomen short, flattened; its dorsal surface, in the well-grown nymph, blackish brown and marked with a pair of distinct dark spots on each segment; ventral side yellowish brown. Abdominal segments from the 2nd to the 6th provided with 2 lateral triangular spine-like long processes directed outwards, but on the 7th with a single process only (Fig. 4j). Gills present on the abdominal segments from the 1st to the 7th; those of the 1st conspicuously enlarged, membranous, kidney-shaped, extending to the base of the 2nd legs and decurved beneath the mesothorax; gills of the segments from the 2nd to the 7th ovoid in shape and with thickened and fringed external margins. Each lamella somewhat reddish in colour and with about 10 palmately-branched purple respiratory filaments (Fig. 4k, 4l, 4m and 4n).

Legs rather large, slender, but robust; femur, tibia and tarsus densely fringed with hairs on the external margins, femur being marked with some irregular dark bands; tarsal claw strong, armed with a basal lateral tooth and also ca. 5 lateral teeth $\frac{2}{3}$ from the base (Fig. 4i). 2 caudal setae, bare, fragile, and usually longer than the body.

Size: Length of body 11–12 mm.

Length of caudal setae 15–17 mm.

Localities: A rapid torrent at Kiyotaki, west of Kyôto (UENO, April, 1926; May, 1927); the Kiso River, at Kiso-Fukushima, Prov. of Shinano (KAWAMURA, November, 1926; K. MIMURA, May, 1927); in many alpine torrents on Mt. Tateyama, etc. (IMANISHI, July and August, 1927).

Notes: This remarkable nymphal form is common in the swiftest part of the torrents in the above-mentioned localities and exhibits a well-marked adaptation as dwellers of such a situation. It is an interesting fact that the present species is in the rapid at Kiyotaki the commonest associate of the larvae and pupae of Diptera-BLEPHAROCERIDAE¹ as observed in the United States by J. G. NEEDHAM².

1) According to Mr. SHIRO KITAGAMI, who has studied Japanese BLEPHAROCERIDAE, three species of *Bibiocephala*, five species of *Phileorus*, one species of *Blepharocera*, and also one species of his new genus of this family are to be found in this locality.

2) 1905, p. 59.

3. *Genus: Ecdyurus* EATON (1868)¹

Nymph: EATON, Rev. Monogr., p. 277; ESB.-PETERSEN (1910), pp. 81-82
LESTAGE (1921), pp. 203-209.

***Ecdyurus japonicus* sp. nov.**

(Plate VI., Figs. 5, 5a-5m)

Description: Body short and strongly flattened dorso-ventrally, being widest across head (Fig. 5) and from the middle of abdomen tapering rapidly. Head very large, thin, flattened, sharp-edged, oblong-elliptical in dorsal view, with rounded frontal margin; yellowish brown and with a pair of white spots between the eyes (Fig. 5). Antennae short and slender, 25-26-jointed and minutely spinulated (Fig. 5a). Mouth-parts are shown in Figs. 5b, 5c, 5d, 5e, 5f and 5g. Labrum rhombic, with pointed infero-lateral borders and the distal margin fringed. Outer margin of mandible densely fringed with long hairs, outermost canine slender and serrated internally. Lacinia of maxilla armed with 3 large flat spines on its summit and with pectinated teeth on the outer margin near the summit, inferior margin closely fringed; proximal joint of maxillary palpus fringed externally and the distal one provided with thick growth of hairs. Median piece of hypopharynx obtuse, lateral pieces nearly oval and slightly recurved at the tip.

Gills present on the abdominal segments from the 1st to the 7th. Each gill lamella provided, except on the 7th, with respiratory filaments (Figs. 5j, 5k, 5l and 5m); lamellae of the 1st somewhat lanceolate, but those from the 2nd to the 6th small and ovoid in shape, the 7th being the smallest and lanceolate.

Of legs, femur broad and flattened, bearing a series of dense hairs and marked with 3 irregular transversal dark bands on the upper side; tibia and tarsus remarkably long and slender; tarsal claw armed with a lateral process and two series of lateral flat sharp teeth, 5 of which

1) *Ecdyurus yoshidae* Y. TAKAHASHI (1924) is reported from Japan, though its locality was not recorded.

being placed proximally and the other 5 distally (Figs. 5h and 5i).

3 caudal setae, longer than body, and minutely setaceous, pale, but several joints near the base brownish.

Size: Length of body 12 mm.

Length of median caudal seta..... 20 mm.

Length of outer caudal setae 17 mm.

Localities: The type specimen was captured by myself on May 26, 1925, under a submerged stone on the wave-beaten shore of Lake Kawaguchi, at Funadzu (lat. 35°60'N.), northern foot of Mt. Fuji, Prov. of Kai.

Localities of the other specimens are as follows: Lake Towada, Prov. Rikuchû (UÉNO, July, 1925); the Asahigawa River near Okayama, western Japan (KAWAMURA, January, 1918); the Yoda River, Prov. Shinano (MOCHIZUKI, November, 1917; January, 1918); a torrent at Minoo, near Ōsaka (UÉNO, July, 1925); the Tenryû River, near Iida, Prov. Shinano (KITAHARA, July, 1926; UÉNO, November, 1926); the Kiso River, at Kiso-Fukushima, Prov. Shinano (K. MIMURA, May, 1927); the Kôtô River, at Akiyoshi, western Japan (UÉNO, May, 1927); the Seta River, Prov. Omi (UÉNO, August, 1927); Kajikawa, Prov. Hizen in Kiushiu (KAWAMURA, August, 1927).

Notes: This is the commonest nymphal form of the Heptageniidae which is widely distributed in Japan, and is found usually on the under-side of stones in brooks, small rapids, rivers, or on open wave-beaten strands of lakes.

***Ecdyurus* (sp. nov. ?)**

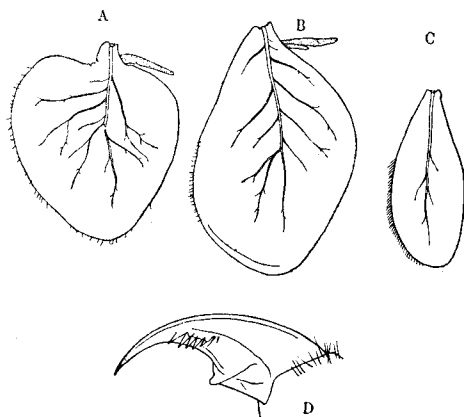
(*Text-figure 2*)

This form was obtained by Mr. K. IMANISHI from 8 stations on alpine torrents of from 1290–2120 m. above sea level in central Japan¹.

In spirit, body, antennae, legs and caudal setae are all pale grayish yellow in colour. Body widest across head and mesothorax. Head large,

1) I wish, here, to express my best thanks to Mr. KINJI IMANISHI of the Entomological Laboratory of this university for his kindness in allowing me to examine his specimens.

frontal margin without fringes. Antennae short, slender and bare. Eyes large; round, on the postero-lateral corners; 3 ocelli. Mouth-parts are similar to those of the preceding *Ecdyurus*. Abdominal dorsum marked



Text-figure 2. *Ecdyurus* (sp. nov.?).

A. Left 1st gill lamella, $\times 26$; B. Left 3rd gill lamella, $\times 26$; C. Left 7th gill lamella, $\times 26$; D. Claw of right 1st leg, $\times 170$.

with irregular indistinct patterns. Gills white, present on the abdominal segments from the 1st to the 7th, on the 1st with a single unbranched and on the 2nd to the 6th branched filaments, the last being without any filaments (Text-figure 2, A, B and C). Legs large; femur armed with a series of stiff setae on the outer margin, but without fringes of hairs as in *Epeorus*; tarsal claw strong, armed with about 5 lateral teeth (Fig. 2, D). Caudal setae nearly as long as the body, bare or minutely ciliated.

Size: Length of body.....7-10 mm.
 Length of antennae 1.8-2.5 mm.
 Length of median caudal seta 7-7.5 mm.
 Length of outer caudal setae.....6.5-ca. 7.5 mm.

Ecdyurus sp. No. 1

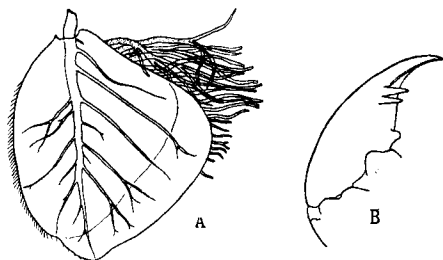
(Text-figures 3 and 4)

A single specimen. Length of body 9 mm.; of antennae 2 mm.; caudal setae broken off. Head, thorax and abdomen pale yellowish; abdominal dorsum marked with grayish brown patterns as shown in

Text-figure 3 A. Ventral side of the body pale except its yellow



Text-figure 3. *Ecdyurus* sp. No. 1.
A. Nymph, dorsal view, $\times 8$; B. Left 2. leg,
 $\times 8$.



Text-figure 4. *Ecdyurus* sp. No. 1.
A. Left 3rd gill lamella, $\times 20$; B. Claw of left
1st leg, $\times 110$.

7 mm., of median caudal seta 12 mm., and of outer setae 10.5 mm.

median line. Of legs, femur broad, flattened and with a irregular dark ring marking on the upper side (Text-fig. 3B); tarsal claw armed with 2 lateral teeth $\frac{2}{3}$ from the base (Text-fig. 4B). Gill lamellae broadly ovate, white, with many respiratory filaments (Text-fig. 4A).

The specimen was taken by Mr. R. TAKAHASHI on October 23, 1927, in a rapid flowing creek at Sôzan, near Taihoku, northern Formosa.

Ecdyurus sp. No. 2

This form was also caught by Mr. TAKAHASHI at Taihoku, northern Formosa (August, 1926). Seven specimens younger and well grown nymphs. In spirit, body, legs and caudal setae are brownish yellow in colour. In the largest individual, the length of body

4. Genus: *Epeorus* EATON (1881)¹

Nymph: EATON, Rev. Monogr., pp. 237-238; E.-PETERSEN (1910), p. 79
LESTAGE (1921), pp. 210-213, Fig. 53.

1) Y. TAKAHASHI (1924) described from Japan the imago of his new species *Epeorus ikanonis*, but he gave no detailed description nor the locality. There are, however, some reasons for believing that there is no relationship between his species and our two *Epeorus*-nymphs here described.

Epeorus torrentium EATON (1885)

Epeorus torrentium EATON. EATON (1885), p. 237, Pl. LVI; LESTAGE (1917), p. 319, Fig. 24, a-h, (1921), p. 213, Fig. 53 a-h.

Localities: A torrent of Omiyadani at Sakamoto, Prov. of Ōmi (UÉNO, June, 1926); a small stream at Yamanaka hot springs, Prov. of Kaga (KAWAMURA, July, 1924); the Tenryū River, near Iida, Prov. of Shinano (UÉNO, March, 1927); the Kiso River, at Fukushima, Prov. of Shinano (MIMURA, March, 1927); the Sēta River (UÉNO, August, 1927).

Epeorus latifolium sp. nov.

(Plate VII., Figs. 6, 6a–6o)

Description: Body and legs pale yellowish or grayish, often brownish; wing-cases grayish yellow or brownish; caudal setæ brown.

Body strongly flattened dorso-ventrally (Fig. 6), broadest across head and mesothorax. Head large, thin, flattened, with fringed infero-lateral margins. Antennae (Fig. 6a) slender, nearly $\frac{3}{4}$ as long as head, having about 33-joints and minutely ciliated. Mouth-parts are hairy as shown in Figs. 6b, 6c, 6d, 6e, 6f, 6g and 6h. Outermost canine of mandible well-developed, broad and serrated internally, the interior canine smaller and shorter. Lacinia of maxilla terminated by 3 stout tubercles of unequal size, with the internal margin bearing 2 long and short series of stiff hairs; maxillary palpus 2-jointed, the distal one of which being densely velvinous at the terminal margin. Labium broad and stout, labial palpus with dense hairs on the distal joint. Median piece of hypopharynx sub-quadrangular, lateral pieces obliquely truncated. Pronotum narrow, its lateral borders rounded at the front corners.

Abdomen flattened; the segments from the 2nd to the 6th with 3 lateral, triangular, curved, spine-like, sharp processes directed outwards and gill-lamellae attached to the center among them (Fig. 6 o); each segment marked with a pair of dark spots on the dorsum. Gills present on the abdominal segments from the 1st to the 7th, those of the 7th being the

smallest. Each gill-lamella obliquely ovate in shape, with thickened external and antero-interior portions; the external margin of the 1st pair fringed, but those from the 2nd to the 6th the margin minutely spinulated at one part and the rest fringed (Figs. 6k, 6l, 6m and 6n); trachea branched arborescently and distributed chiefly at the internal thinner part. All lamellae have finger-shaped purple respiratory filaments. Gill lamellae of the present form differs greatly from those in other *Epeorus*-nymphs in: (i) their size being conspicuously larger and (ii) they being reddish purple in colour and mottled on their internal thinner portion with distinct large and small round reddish brown or dark brownish red spots.

Legs strong, fringed with long hairs on the external margins; femur large, broad and marked with 2 dark bands on the upper side; tibia and tarsus long and slender; tarsal claw armed with 5 distinct large lateral teeth at about $\frac{2}{3}$ from the base (Figs. 6i, 6j). 2 caudal setae, thick and slightly longer than the body.

Size: Length of body..... 11 mm.

Length of caudal setae 12.5 mm.

Localities: The type specimen was taken by Professor T. KAWAMURA on September 14, 1917, in a small inlet stream 'Shirisetunai' of Lake Shikotsu (lat. $42^{\circ}45'N.$), Prov. of Iburi in Hokkaidô.

Similar forms have been also collected from: a swift torrent at Kiyotaki, west of Kyôto (UÉNO, April, 1926; May, 1927); the Iwakuni River, Prov. of Suwô, western Japan (YAMANOUCHI, April, 1922); Katajiri or the natural outlet of Lake Tazawa (lat. $39^{\circ}43'N.$), Prov. of Ugo (KAWAMURA and UÉNO, July, 1925)¹; the Tenryû River, at Iida, Prov. of Shinano (UÉNO, Sept., 1926); the Kiso River, at Kiso-Fukushima, Prov. of Shinano (MIMURA, April, 1927); the Kôtô River, at Akiyoshi, western Japan (UÉNO, May, 1927); in many mountain torrents of from 970-1686 m. above sea level, in the prov. of Shinano and Hida (IMANISHI, July-August, 1927).

Notes: This nymphal form is always found under stones in rapid

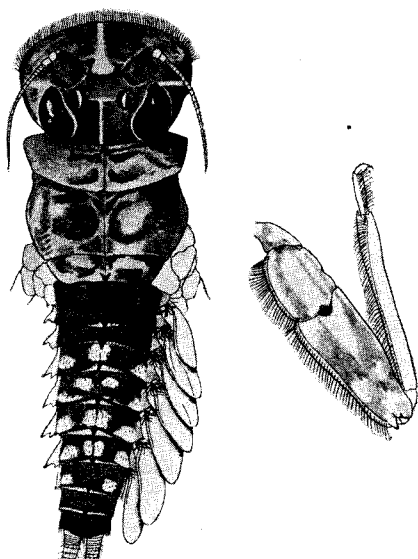
1) We collected in this brook a number of a caddis-worm *Phylopotamus* and one of the aquatic Rhyncota *Aphelocheirus nawae* MATSUMURA.

torrents and rivers or open wave-beaten shores of larger lakes, and seems to be widely distributed throughout Japan, although I have never had an opportunity to observe the imago of this nymph. This nymph is also distributed in torrents on higher mountains, such as, the so-called Japanese Alps in central Japan, where its altitudinal distribution was observed to be as high as about 1700 m. above sea level, at which the temperature is so low as ca. 5°C by day in August. In such high elevations, the full grown nymph (as large as 16mm.), which becomes a darker purplish brown, is taken at the middle of August, and therefore the emergence of the subimago will probably occur in those days, although it has been overlooked in its imago stage because collections have not been made at the right date.

***Epeorus* sp. (sp. nov.?)**

(Text-figure 5 and 6)

This *Epeorus*-nymph is the most remarkable one having a conspicuous mid-dorsal tubercle on the hinder margin of each abdominal



A. Nymph, dorsal view, $\times 12$; B. Right leg, $\times 12$.

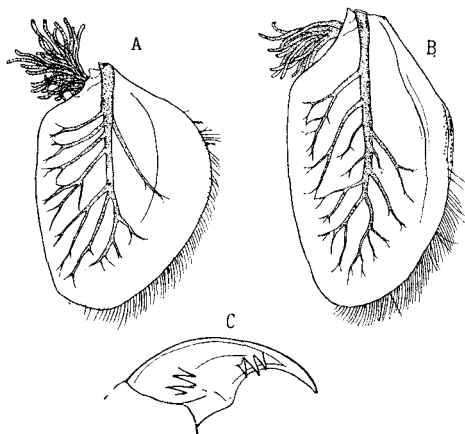
segment (Text-fig. 5A). Body, legs and caudal setæ are all purplish brown in colour. Abdominal dorsum of segment from the 4th to the 8th are marked with distinct white spot as shown in the accompanying figure. 7 pairs of gills, white, large and elliptical-ovate in shape, and provided with purple-coloured respiratory filaments (Text-fig. 6, A and B). Each pair of gill lamellæ covering those behind them, the 7th attaining a little beyond

the hind margin of the last abdominal segment. Tarsal claw strong, armed with both 3 inferior and basal-lateral teeth (Text-fig. 6,C).

Size (in mm.):

| Localities | Sozan | Urai |
|-----------------------|-------|-------|
| Length of body | 9 | 7 |
| Length of antenna | 2.5 | 2 |
| Length of caudal seta | 7.5 | ca. 6 |

Localities and notes: Formosa. 4 nymphs (2 of which the younger specimens being as large as 3.5mm.) were collected by Mr. R. TAKAHASHI in a rapid at Sôzan, near Taihoku, (October 23, 1923). Another specimen of a similar form was taken by him on October 17, 1927, at Urai. In the last named locality, its associate is a curious immature form of a stone-fly *Peltoperl*¹.



Text-figure 6. *Epeorus* (sp. nov.?).
A. Right 1st gill lamella, $\times 42$; B. Right 2nd gill lamella, $\times 42$; C. Claw of 2nd leg, $\times 125$.

III. Family: *Baetidae*.

Key to the Japanese genera of *Baetidae*.

- a. Outer caudal setae fringed on both sides².
- b. 7 pairs of gills inserted laterally on abdominal segments 1st to 7th.

1) There has been recorded from Formosa *Peltoperl*¹ *formosana* KLAPÁLEK (1913, *Entom. Mitt.*, I, Nr. 11, p. 123) [LESTAGE, 1927—*Recueil de l'Institut zoologique* Torley-Rousseau, T. I, fasc. 1, 1927, p. 84]. On this Formosan *Peltoperl*¹-nymph, I shall report in the other paper following this.

2) Sometimes bare or minutely ciliated.

- c.* gills long, double and filamentous.....1. *Paraleptophlebia*.
- cc.* 1st pair of gills elongated lanceolate, but the other 6 pairs lamelliform and trifurcated at the tip.....2. *Choroterpes*.
- bb.* 5 or 6 pairs of gills present on dorsum of abdominal segments, double, but not linear, one pair more or less elytrid.
 - c.* 5 pairs of gills present on abdominal segments 3rd to 7th; a pair of dorsal tubercles on hind margin of each abdominal segment; maxillary palpus shorter than lacinia 3. *Ephemerella*.
 - cc.* 6 pairs of gills present on abdominal segments 1st to 6th, on the 1st segment linear, but on the 2nd large, quadrangular and elytrid, covering the four pairs of gills behind; no dorsal abdominal tubercles as in *c*; maxillary palpus longer than lacinia 4. *Cenis*.
- aa.* Outer caudal setæ fringed on inner sides only.
 - b.* Body cylindrical, but somewhat depressed; postero-lateral angles of hinder abdominal segments not produced into lateral spines.
 - c.* Gill-lamellæ double or at least so on some of the anterior segments; the last joint of labial palpus obliquely cut..... 5. *Cloëon*.
 - cc.* Gills simple in all pairs and obtuse at the apex; the last joint of labial palpus not obliquely cut as in *c*.
 - d.* 3 caudal setæ, remarkably fringed; the last joint of labial palpus somewhat dilated distally and rounded ... 6. *Baëtis*.
 - dd.* 2 caudal setæ, slightly fringed; the last joint of labial palpus conical and acuminate at the summit..... 7. (?) *Accontrella*.
- bb.* Body cylindrical, but abdomen somewhat flattened; postero-lateral angles of hinder abdominal segments produced into thin, flat, sharp lateral spines.
 - c.* Fore-legs conspicuously fringed with series of long stiff setæ; gill-tufts present upon the bases of maxillæ, coxæ of fore-

- legs and bases of abdominal covering lamellæ which are usually dorsal and erect..... 8. *Chirotoneles*.
cc. Fore-legs without such conspicuous fringes as in *c*; no maxillary or caudal gills; abdominal gills without any gill-tufts and double on the anterior segments.....9. *Siphururus*.
-

1. *Genus: Paraleptophlebia* LESTAGE (1917)

Nymph: LESTAGE (1917), p. 342, Fig. 27, (1921), pp. 222-225, Fig. 56.

***Paraleptophlebia* (?)*cincta* (RETZIUS)**

(Plate VIII., Figs. 7, 7a-7j)

The following description is based upon only two poorly preserved old specimens.

Description: Body slender and remarkably elongated and cylindrical, gradually tapering backwards (Fig. 7). Head of moderate size, wider than prothorax and nearly triangular in dorsal view. Eyes lateral. Antennae (Fig. 7a) slender, about $\frac{1}{2}$ as long as body, setaceous and brownish. Abdominal dorsum marked with a deep brown colour-pattern as shown in Fig. 7, the ventral side of abdomen pale yellowish. Pronotum and mesonotum brownish. Mandible short, broad, with two strong and acute canines, appendage tapering into a compact brush (Fig. 7c, 7d). Lacinia of maxilla (Fig. 7e) short, broad, truncated, bearing long hairs; maxillary palpus slender and pilose. Of labium, glossae oblong-ovate and paraglossae semi-ovate, their inner margin excavated (Fig. 7f). Median piece of hypopharynx obovate, lateral pieces obtuse (Fig. 7g).

Legs slender and weak; tarsal claw slender, pointed and armed with about 10 to 12 minute inferior denticles (Fig. 7h).

Gills present on abdominal segments from the 1st to the 7th, 2-leaved, linear acuminate, purplish, the margins from the 2nd to the 7th beset with minute hairs.

Caudal setæ long and provided with minute hairs; several joints

near the base blackish brown, but the other distal joints pale yellow in colour.

Size: Length of body 9.5 mm.

Remarks: The caudal setæ of *Leptophlebia* (*Paraleptophlebia* LESTAGE) *cincla* have been described as being nearly $1\frac{1}{2}$ times as long as the entire body. Unfortunately, the setæ in our specimens had been broken off in part and lost, so that it was impossible to know exactly the relative length of them to the body length. But the examination of many other important features, and the comparison of the illustrations of the nymph of *L. cincla* in EATON's 'Rev. Monographs' have revealed us that these two specimens are undoubtedly identical with *Paralept. cincla*.

Locality: 2 specimens obtained by Prof. T. KAWAMURA on July 8, 1924, in a small creek at Yamanaka hot springs, Prov. of Kaga.

2. *Genus*: **Choroterpes** EATON (1881)

Nymph: EATON, Rev. Monogr., p. 105; LESTAGE (1921), pp. 228-229.

Choroterpes trifurcata sp. nov.

(Plate XV., Figs. 16, 16a-16f)

Description: Body somewhat depressed, widest across prothorax. Head large, slightly narrower than pronotum; eyes dorso-lateral; 3 large ocelli, lateral two of which being reniform (Fig. 16). Antennae, in my materials, are all partly broken off and lost. Of mandibles (Figs. 16c, 16d), canines slender, elongated and toothed, molar in a large measure. Maxillary palpus slender and longer than lacinia, the 1st joint slightly shorter than the 2nd and the 3rd together. Of labium (Fig. 16e), glossae very small and semi-ovate, paraglossae large, broadly rounded; labial palpus slender and 3-jointed. Pronotum short, with lateral margins straight, antero-lateral angles rounded, somewhat arched dorsally and yellowish brown. Legs slender (Fig. 16f); hind legs a little the longest; pale yellowish, marked with irregular dark bands on femur; tarsus (claw excluded) nearly $\frac{1}{3}$ as long as tibia; tarsal claw well-developed, armed with a series of pectinations of about 14 flat

spines on the internal margin (Fig. 16g). Abdomen somewhat flattened, dorsum yellowish brown and with dark markings except on the median line; each abdominal segment produced into flat acute but short spines at its postero-lateral corners (Fig. 16). Gills present on the abdominal segments from the 1st to the 7th, on those from the 2nd to the 7th double, purplish, lamelliform, and divided into 3 long linear branches at the tip (Fig. 16i, 16j), while on the 1st being single and linear filament (Fig. 16h). Caudal setæ longer than body and minutely ciliated.

Size: Length of body 5.0 mm.

Length of median caudal seta 6.8 mm.

Antennae and outer setæ broken off and lost.

Remarks: This nymph is very closely related to that of the European *Ch. picteti* EATON in its mouth-parts, legs, etc., but, as far as I have studied in the literature, I have never come upon a nymph that has such remarkable trifurcated gill-lamellae. For this reason, I regard this nymph for the present as a new species.

Localities: 3 specimens collected by Mr. R. TAKAHASHI in Aug., 1926, in a stream at Taihoku (lat. ca. 25° N.), Formosa. Yet unknown in Japan proper.

3. Genus: *Ephemerella* WALSH (1862)

Nymph: EATON, Rev. Monogr., pp. 125-126; E.-PETERSEN (1910), p. 75;

LESTAGE (1917), p. 358, (1921), pp. 232-235.

This genus includes the most striking nymphal forms which show great specialization in form and variability in size. They are, together with some *Heptageniidae*-nymphs, one of the most important elements of the brook-fauna in the Kyôto region, and are usually found under stones or on the bed of the streams in those localities. NEEDHAM¹ has pointed out that "the nymphal differences are chiefly in the number and arrangement of the gill lamellae," and he explained that "these things are perhaps most subject to the influence of environment." The facts

¹) 1905, p. 41.

are also true of our nymphs. Of the four *Ephemerella*-nymphs, three seem never to have appeared in the literature of the mayfly nymphs until now, and hence are regarded as new for the present.

Key to the Japanese species of the Ephemerella-nymphs.

- a.* Head without any frontal spines.
 - β.* Caudal setæ longer than body; body of moderate size.....*E. longicaudata* nov.
 - ββ.* Caudal setæ shorter than body; body small, short and blackish.
.....*E. nigra* nov.
- aa.* Head with frontal spines.
 - β.* With 2 short tubercle-like frontal spines.....*E. tuberculata*.
 - ββ.* With 3 conspicuous frontal spines; caudal setæ fringed remarkably; femur of the fore-leg armed with a series of stout teeth.....*E. trispina* nov.

***Ephemerella longicaudata* sp. nov.**

(*Plate VIII., Figs. 8, 8a, 8i-8l; IX., Figs. 8b-8h*)

Description: Body somewhat flattened, widest across mesothorax and 4th abdominal segment (Fig. 8). Head short, narrower posteriorly and arched above. Antennae long, slender, filiform and slightly ciliated (Fig. 8a). Eyes lateral, 3 small ocelli on the vertex of head. Pronotum rectangular, about $\frac{1}{3}$ as long as wide and arched above. Mesonotum broad, slightly arched above and excised at the antero-lateral corners. Abdomen more flattened than the thorax, broadest at the 4th abdominal segment and thence tapering rapidly toward the cauda. Lateral margins from the 3rd to the 7th abdominal segments terminate in acuminate flat spines. Each abdominal segment from the 3rd to the 8th is armed on the dorsal surface with a pair of symmetrical short tubercles directed backwards (Fig. 8).

. Mouth-parts are as shown in Figs. 8b, 8c, 8d, 8e, 8f, 8g and 8h. Mandibles short and stout; outer canine strong, terminated into 2 apical

teeth, and serrated internally; internal canine smooth. Lacinia of maxilla large, terminated into 2 large curved spines; maxillary palpus very small, about $\frac{1}{3}$ as long as lacinia. Terminal joint of labial palpus rudimentary; glossae small, but paraglossae large and obtuse-ovate.

Gills present on abdominal segments from the 3rd to the 7th, double (Figs. 8, 8i, 8j, and 8k). Each posterior lamella is invisible from above because it is covered by the immediately preceding one; the former, posterior lamella, V-shaped, shorter than the anterior and its margin cut into about 14 small lobes (Fig. 8i), but the latter, anterior lobe, sub-quadrangular and acutely pointed at the inner apical angle (Fig. 8i, 8j); lamellae on the 7th segment very small and the posterior lamellae not cut into as in the preceding 4 pairs (Fig. 8k).

Legs long and slender; tarsal claw armed with about 10 to 12 inferior minute teeth (Fig. 8l). Caudal setae strong, somewhat elastic and longer than the entire body.

Body, legs and caudal setae grayish olivaceous yellow in spirit.

Size: Length of body..... 12 mm.

Length of median caudal seta..... 14.5 mm.

Length of outer caudal setae..... 12.5 mm.

Remarks: The present nymph is closely allied to that of the North American *Ephem. bispina* of NEEDHAM¹, but can be distinguished from that by the following features: (i) Maxillary palpus very short, almost $\frac{1}{3}$ as long as lacinia (in *E. bispina* hardly half as long as lacinia). (ii). Gill lamellae acutely pointed at the inner apical angle (in *E. bispina* it is obtusely pointed). (iii). Caudal setae about $1\frac{1}{2}$ times as long as body.

Locality: Lake Biwa, Prov. of Ōmi.

3 specimens are preserved in the Ōtsu Hydrobiological Station which were taken by Mr. M. MOCHIZUKI on May 21, 1918, under a stone on the shore of L. Biwa near the Station.

1) 1905, p. 43.

Ephemerella nigra sp. nov.*(Plate IX., Figs. 9, 9a-9n)*

Description: Body and legs remarkably brownish black in colour and often with a distinct white mid-dorsal line (Fig. 9).

Body short, stout, rather flattened, broadest at prothorax. Head small, much narrower than prothorax; eyes prominently lateral. Antennæ (Fig. 9a) short, sparingly setaceous, with about 27 joints and brown in colour. Pronotum large, rectangular, $\frac{1}{2}$ as long as wide, remarkably arched above, with straight lateral margins and antero-lateral angles excised. Mouth-parts are as shown in Figs. 9b, 9c, 9d, 9e, 9f and 9g. Labrum sub-quadrangular. Mandible short, broad, with strong and acute canines and small molar. Lacinia of maxilla short, truncated, hairy and with 2 large, curved, serrated spines and 5 smaller spines at the terminal end; maxillary palpus nearly as long as the lacinia. Terminal joint of the labial palpus rudimentary.

Abdomen short and more flattened than thorax, about half as long as wide, with lateral margins spinulated and from the 4th to the 8th segments terminated into flat lateral spines curved posteriorly. On the dorsum of abdominal segments from the 3rd to the 9th present a pair of symmetrical pointed tubercles directed backwards (Fig. 9j). Ventral side of abdomen flat or slightly concave and reddish brown in colour. Gills present on abdominal segments from the 3rd to the 7th, double, that of the 7th being very small and covered by the preceding elytroid one. Each anterior gill lamella thin, membranous, ovoid in shape, bearing fine hairs along the margin and gray in colour; each posterior lamella from the 1st to the 3rd pair is U-shaped one, each lobe of which cut into about 8 small lobelets (Fig. 9k), while the 4th is not U-shaped (Fig. 9l) and the 5th has only a few lobed lamella (Fig. 9m).

Legs strong; femur spinous, tibia and tarsus hairy; tarsal claw armed with about 6-8 inferior teeth of unequal size (Fig. 9h and 9i). Caudal setæ slender, about $\frac{3}{4}$ as long as the body and minutely

ciliated.

Size: Length of body..... 8 mm.¹

Length of median caudal seta 5 mm.

Length of outer caudal setæ 4.8 mm.

Localities: More than 100 specimens were collected by Prof. T. KAWAMURA and Mr. S. KITAGAMI on May 5, 1926, in a rapid "Toyama-zawa" (at about 1400 m. above sea level) near Yumoto hot springs at Nikkô, Prov. of Shimotsuké.

Some more specimens from: a rapid torrent at Kiyotaki, west of Kyôto (UENO, April, 1926); the Tenryû River, near Iida, Prov. of Shinano (UENO, September, 1926); the Kiso River, at Kiso-Fukushima (MIMURA, May, 1927).

Remarks: Such a nymphal form of *Ephemerella* has never appeared in the literature, so far as I know. This attractive form is usually found attached to the sides of, or often under stones in running streams. Sometimes it is grubbed up from the muddy bed on the bottom of a stream, when its body and legs may be come upon covered with silt. It is interesting that this nymph is often seen in the barricade of stones of the caddis-worms, *Rhyacophila* and *Philopotamus*.

***Ephemerella* (?)*tuberculata* MORGAN**

(Plate X., Figs. 10, 10a)

Unfortunately, the only specimen obtained by Prof. T. KAWAMURA in the River Asahigawa near Okayama and kept in the collection of the Ôtsu Hydrobiological Station became dessicated, so that it can not be examined in detail. From the various features still recognizable, however, it is almost certainly *E. tuberculata* MORGAN. No other specimen has ever been gathered.

***Ephemerella trispina* sp. nov.**

(Plate X., Figs. 11, 11a-11n)

Description: Body robust, broadest across mesothorax (Fig. 11);

1) Often reaches 11 mm.

colour grayish brown, dirty, covered with silt. Head short and much narrower posteriorly, and armed with 3 distinct large frontal spines, one median straight and the other two lateral curved inwards (Fig. 11, 11a). Eyes large and lateral. Antennae (Fig. 11b) short and slender, minutely spinulated. Pronotum large, about $\frac{3}{4}$ as long as wide, rectangular in shape, with straight anterior and lateral margins, posterior margin well-defined, and slightly arched above. Mouth-parts are as shown in Figs. 11c, 11d, 11e, 11f, 11g and 11h. Mandible slender; outer canine broad, acute, with 3 teeth at apex; inner canine larger and pointed. Lacinia of maxilla terminating into 2 large, stout tubercles, a strong curved serrated spine and several small spines; maxillary palpus $\frac{2}{3}$ as long as lacinia, 2 distal joints together nearly as long as the proximal. Terminal joints of labial palpus only a conical rudiment.

Abdomen flattened, broadest at the 5th segment and thence tapering rapidly toward the cauda; postero-lateral corners from the 3rd to the 7th segments form each an acute spine directed backwards; on the dorsum of from the 2nd to the 7th segments a pair of large, strong tubercles present; the ventral side of abdomen flat or somewhat concave and reddish or reddish yellow in colour. Gills present on the abdominal segments from the 3rd to the 7th, double, of the 7th being the smallest (Fig. 11k, 11l, 11m and 11n). Each anterior lamella thin, membraneous, obtuse ovoid, with thickened external margin and trachea arborescently developed; each posterior lamella, except on the 7th, cut into many small lobelets (Fig. 11l, 11m).

Legs very strong; femur of fore-leg large, robust and flattened, widest before the middle and the inner margin armed with a number of strong teeth of unequal size (Fig. 11i); the infero-terminal corner of tibia elongated in a long spine-like process; tarsal claw armed with about 4 small inferior teeth near the base. Femur of each leg marked with 2 dark brown bands on the upper side, but tibia marked with only one black band (Fig. 11j).

Caudal setae about $\frac{3}{4}$ as long as the entire body and pale-yellowish; the median seta fringed on both sides, while the outer two setae

are fringed only on the inner side with long, white hairs, and on the outer side with short stiff hairs.

Size: Length of body..... 10.5 mm.

Length of antenna 1.5 mm.

Length of median caudal seta 8.0 mm.

Length of outer caudal setæ..... 7.5 mm.

Localities: 4 specimens were obtained by myself on May 19, 1926, under stones in a swift torrent in Ômiya-dani, Mt. Hiei, Prov. of Ômi.

Also from: a rapid torrent at Kiyotaki, west of Kyôto (UENO, June, 1926); the Oshibora River, southern part of the Prov. of Shinano (KITAHARA, June, 1926); the Tenryû River, near Iida, Prov. of Shinano (KITAHARA, June, 1926; UENO, Sept., 1927).

Notes: This is the most curious form of *Ephemerella*-nymphs in Japan which has 3 distinct spines on the head. It is found attached to the sides of stones in swift torrents or rapid streams and has a body form remarkably well-adapted for such a situation. At the type locality, the larvæ of the net-winged midges are one of the commonest associates of this form, as in the case of *Iron* (already described in page 29).

4. *Genus*: **Caenis** STEPHENS (1835)

Nymph: VAYSSIÈRE (1882), p. 71; EATON, Rev. Monogr. pp. 141-142;
E.-PETERSEN (1910), p. 76; LESTAGE (1921), pp. 243-246.

Caenis sp.

(Plate XVI., Figs. 17, 17a-17m)

Description: Head, pronotum and mesonotum and wing-cases brown, abdomen brownish above and pale ventrally; antennae, legs and caudal setæ pale.

Body small and delicate, widest across pronotum. Head narrower than prothorax; eyes lateral; 3 ocelli, the lateral two of which being close to the eyes (Fig. 17a). Antennae slender, weak, ciliated and

about $\frac{1}{2}$ as long as the body (Fig. 17b). Lateral borders of the broad pronotum dilated and slightly prolonged in front. Mouth-parts are shown in Figs. 17c, 17d, 17e, 17f, and 17g. Maxillary palpus longer than lacinia (Fig. 17e). Of labium (Fig. 17f), glossae and paraglossae almost of similar size, labial palpus with the rounded last joint of moderate size. Abdomen narrowed posteriorly, some posterior segments being remarkably less in breadth than the anterior ones. Gills are present on the abdominal segments from the 1st to the 6th; on the 1st a rudimentary, rod-like simple filament issuing from the anterolateral margin of the segment (Fig. 17i), on the 2nd an enlarged quadrangular elyroid, coriaceous, with margins fringed with long stiff hairs and covering completely those 4 pairs of gills behind (Fig. 17h, 17j), while from the 3rd to the 6th smaller, delicate, thin and membranous lamellæ, ovate-triangular in shape and fringed with long, branched, respiratory filaments; these 4 pairs of gills are arranged imbricately under the elyroid gill covers (Fig. 17h, 17k, 17l). Legs slender; hind-legs the largest, tarsus (claw excluded) about as long as the tibia; claw smooth (Fig. 17m). Caudal setæ weak and minutely ciliated.

Abdomen and elyroid gill-covers beset with short hairs and covered with silt.

| | |
|------------------------------------|---------|
| <i>Size</i> : Length of body | 3.8 mm. |
| Length of antenna | 1.8 mm. |
| Length of median caudal seta | 2.5 mm. |
| Length of outer caudal setæ | 2 mm. |

Locality: Formosa.

I found this attractive nymph (2 specimens) in a collection of Mr. S. ISSHIKI's on May 27, 1927, in a rapid at Rai-sha (lat. ca. $22^{\circ}30'$ N.), Southern Formosa. No records from Japan proper.

5. *Genus*: **Cloëon** (L.) BENGTSSON (1914)

Nymph: EATON, Rev. Monogr., pp. 180-181; E.-PETERSEN (1910), pp. 76-77
LESTAGE (1921), pp. 248-253.

Cloëon dipterum (LINNÉ 1761) BENGTSSON

(Plate XI. Figs. 12, 12a—12j)

Imago: EATON, Rev. Monogr., p. 182; MATSUMURA (1905), p. 161, Pl. X., fig. 11.*Nymph*: Klapálek (1909), p. 20; E.-PETERSEN (1910), p. 77, Fig. 68-59;

LESTAGE (1917), p. 395, Figs. 42a-j, (1921), p. 253, Figs. 66a-j.

Description: Body elongated, cylindrical, broadest across mesothorax (Fig. 12). Face vertical and eyes lateral. Antennae (Fig. 12b) slender, nearly as long as the body and slightly setaceous. Pronotum narrowed anteriorly, with rounded lateral margins. Mouth-parts are shown in Figs. 12c, 12d, 12e, 12f, 12g, and 12h. Lacinia of maxilla terminating in a short strong tubercle and the internal margin provided with a series of flat spines; maxillary palpus slender, and longer than lacinia. Distal joint of labial palpus broadened distally and obliquely truncated at end. Legs slender and weak; tarsal claw sharply pointed and armed with about 10 spinules (Fig. 12i).

Abdomen cylindrical, gradually tapering backward. Gills present on segments from the 1st to the 7th, double except the hindmost, and the 3rd the largest. Gill-lamellæ all similar in shape, foliaceous, and ovate; trachea plumately branched (Figs. 12j, 12k, 12l, 12m, 12n and 12o). Caudal setæ slender and tapering, pale, several joints at about the middle blackish brown (Fig. 12); outer setæ fringed on the inner side only, but the median seta decked on both sides with long soft hairs.

Body and legs gray-yellowish green, male being somewhat darker; each abdominal dorsum marked with blackish colour-patterns.

Size (in mm.):

| | Female | Male |
|------------------------------|---------|------|
| Length of body | 10-11 | 8.5 |
| Length of median caudal seta | 6.2-6.5 | 6.5 |
| Length of outer caudal setæ | 7-7.8 | 7.0 |

Localities: Kyôto (UENO, April and May); Minoo, near Ôsaka (M. MOCHIZUKI, May, 1918).

Notes: In the Kyôto region, this species is the commonest ephemeropterid found usually in small silty pools such as are found with luxuriant growths of cyperaceous plants and covered with *Spirodela*; e. g., I took it in a small shallow pool in the Botanical Garden of the Imperial University, where it lives in the quiet muddy bottom or may be seen hanging among the sedge-vegetation. In this region, the emergence of the sub-imago and the imago occurs at the end of April, lasting to the middle of May.

6. *Genus*: **Baëtis** LEACH (1815)

Nymph: EATON, Rev. Monogr., p. 157; E.-PETERSEN (1910), p. 78; LESTAGE (1921), pp. 257-261.

Baëtis bioculatus (LINNÉ)

(Plate XII., Figs. 13, 13a-13n)

EATON, Rev. Monogr., p. 158; KLAPÁLEK (1909), p. 18 [*Imago*]; LESTAGE (1917), p. 408.

Coloration: Head and thorax brownish; abdomen pale, with dark brownish markings on the dorsum; gill-lamellæ somewhat purplish; caudal setæ and legs pale yellowish.

Size: Length of body 9.5 mm.

Length of median caudal seta 4.0 mm.

Length of outer caudal setæ..... 4.8-5 mm.

Localities: One specimen was obtained under a stone in a small inlet creek of Lake Towada, Prov. Rikuchû (KAWAMURA and UÉNO, July 1925) and the others from a small torrent 'Shirisetunai' near Lake Shikotsu, Prov. of Iburi, Hokkaidô.

7. Genus: *Acentrella* BENGTSSON (1912)¹? *Acentrella* (sp. nov. ?)

(Plate XVII., Figs. 18, 18a-18k)

Among numerous mayfly nymphs that were collected by Mr. K. IMANISHI during the summer of 1927 in many mountain torrents high up on the so-called Japanese Alps, some 971-1900 m. above sea level, I found a number of nymphs which seem to correspond to the present genus *Acentrella*. Descriptions are given below.

Description: Body elongated and cylindrical, widest across mesothorax; thorax somewhat depressed. Head narrower than pronotum, face vertical, yellowish, marked with a series of brown spots between the eyes as shown in Fig. 18; eyes large and lateral; 3 ocelli. Antennae robust, $\frac{1}{3}$ as long as the body. Anterior margin of pronotum excavated, lateral margins rounded, pale and marked with brown patterns in the middle portion. Mesonotum dark brown. Mouth-parts resemble much those of *Baëtis* as shown in Figs. 18b, 18c, 18d, 18e, and 18f. Labrum (Fig. 18b) quadrangular, with rounded frontal margin and armed with a series of spines and fringes. Mandibles (Fig. 18d, 18e) similar in shape to those of *Baëtis*. Maxillary palpus as long as lacinia, its last joint being slightly longer than the proximal one. Labium (Fig. 18f), with palpus 3-jointed, of which the basal joint being nearly as long as the distal two together, the last joint short, rounded, conical, acuminate at the summit and not dilated distally as in *Baëtis*, and armed with short spines; glossae and paraglossae narrow, the former nearly as long as the latter; prementum narrow.

Abdominal segments yellowish, and some posterior ones, excluding the mid-dorsal line, darker; each segment with a pair of dark-brown linear markings on dorsum, but on the last three segments these markings change into round spots (Fig. 18g). The ventral side of each

1) I was unable to see BENGTSSON's original description (1912, *Entom. Tidskr.* p. 110). Key and description of the nymph are in LESTAGE's Monograph (1921, p. 248 and 257).

segment, excepting the last two, is marked with a pair of two rows of brown lanceolate spots (Fig. 18h). Gill-lamellae present on the abdominal segments from the 1st to the 7th, small, simple, white broad, elliptical-ovate in shape, the margin provided with minute long hairs (Fig. 17a, 17i, 17j); trachea indistinct.

Legs long and slender (Fig. 18k); tarsus $\frac{1}{2}$ as long as tibia, both provided with a series of hairs along external margins; tarsal claw strong, pointed, armed with 6-8 stout inferior teeth and a stiff seta near tip (Fig. 18h). 2 caudal setae, stout, somewhat elastic and longer than the entire body.

Size: Length of body 5.5-6 mm.
 Length of antennae 1.5-2 mm.
 Length of caudal setae 8-8.5 mm.

8. *Genus*: **Chirotonetes** WALKER (1853)

Nymph: EATON, Rev. Monogr. pp. 203-204; LESTAGE (1917), p. 420 and (1921), pp. 262-264.

Chirotonetes (?) **japonicus** ULMER (1919)

(*Plate XIII., Figs. 14, 14a-14o*)

ULMER (1919), pp. 59-51 [Description of the imago].

Description: Head, thorax and abdomen of a beautiful chocolate brown, paler in legs and ventral side of abdomen; on the dorsum of body a broad white median stripe running from the vertex of head to the last abdominal segment (Fig. 14).

Body robust, cylindrical, widest across mesothorax. Head in dorsal view nearly semi-circular and remarkably narrowed anteriorly. Pronotum narrow, about $\frac{1}{3}$ as long as wide and prominently arched above (Fig. 14 and 14a). Antennae (Fig. 14b) long, robust, minutely setaceous, 2 basal joints even stouter. Mouth-parts hairy as shown in Figs. 14c, 14d, 14e, 14f, 14g and 14h. Labrum nearly quadrangular, armed with wiry bristles on the outer surface and fringed with long hairs around the margins. Mandible thick and broad, the

outer canine slender and di- or tri-dentate, the inner one also tridentate; molar small and smooth. Of maxilla, palpus 2-jointed, hairy; lacinia terminating in a long, straight, sharp spine, and a tuft of gill filaments attached to the base. Labium stout, palpus remarkably large and long, 2-jointed, of which the basal joint is cylindrical, naked, but the distal one twice as long as the proximal, with a straight inner margin and an arched outer one and the exterior border fringed with a line of long setae; paraglossae elongate-triangular in outline, glossae small and round-triangular.

Abdomen corpulent, cylindrical, arched above, flattened and carinate laterally, with strong integuments; postero-lateral angle of hinder segments prolonged into a sharp, flat, lateral spiniform process directed backwards (Fig. 14, 14k). Gills present on the abdominal segments from the 1st to the 7th, and covered by stout lamellae. Each protecting lamella nearly ovoid in shape, with the outer margin strongly chitinized and armed with minute teeth and hairs; a tuft of flat, purplish, 2-3 ramified gill filaments attached to the base of the under side of each protecting lamella (Figs. 14l, 14m, 14n and 14o).

Legs strong; each femur marked with 2 dark brown bands on the upper sides, tibia and tarsus with only a single black band (Figs. 14, 14i and 14j). Of fore-legs, antero-ventral borders fringed with a series of well-developed long setae, single on tarsi and double on tibiae and femora; the distal end of tibia beset with a single long strong spine (Fig. 15i); a large tuft of forked gill filaments attached to the coxae of fore-legs (Fig. 15i). Caudal setae thin, rapidly tapering toward the end, closely fringed with tawny hairs which disappear at the distal portion; several joints at about $\frac{3}{5}$ from the base markedly darker (Fig. 14).

*Localities*¹: The Tenryû River, near Iida, in the southern part of the Prov. of Shinano (UENO, Sept., 1926).

The other localities are: the Yoda River, Prov. of Shinano (M.

1) ULMER has stated that *Ch. japonicus* is distributed in Japan and Korea and has described that 1 ♀ and 1 ♂ of the imago were collected at Gifu during April and May.

MOCHIZUKI, Sept., 1917); a torrent at Minoo, near Osaka (UÉNO, June, 1925); a torrent at Kibune, north of Kyôto (UÉNO, April, 1927); a stream at Yamanaka, Prov. of Kaga (UÉNO, July, 1927).

Notes: This nymph is very agile and abounds in our rapid streams. The specimen used in the preceding description came from a small creek with muddy bottom along the Tenryû River. In this locality I have observed it swimming skilfully by strokes of its flat abdomen and powerful caudal setæ, and wandering here and there among the submerged stones. Sometimes it was found under stones or in the crevices of submerged stones or rocks and often supporting its body with the strong fore-legs on the surface of a stone.

9. *Genus: Siphylurus* EATON (1868)¹

Nymph: EATON, Rev. Monogr., pp. 215-216; EL-PETERSEN (1910), p. 79;
LESTAGE (1921), pp. 264-266.

Siphylurus (?) *alternatus* SAY²

(*Platc XIV., Figs. 15, 15a-15l*)

Three specimens which were taken by Mr. M. Iwai in 1915 are preserved in the Ôtsu Hydrobiological Station.

In spirit, the body a grayish yellow, legs and seta dirty yellowish.

Size: Length of Body 15 mm.
Length of median caudal seta 6.5 mm.
Length of outer caudal setæ 7.4 mm.

1) *S. sapporensis*: MATSUMURA was described from northern Japan.

2) EATON, Rev. Monogr., p. 219; NEEDHAM (1901), pp. 423-425.

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EXPLANATION OF PLATES

Plate III.

Ephemera japonica ?

- Fig. 1. Nymph, dorsal view, $2\frac{1}{2}$.
 Fig. 1a. Abdomen, ventral view, $\times 2\frac{1}{2}$.
 Fig. 1b. Right antenna, $\times 12$.
 Fig. 1c. Labrum, $\times 20$.
 Fig. 1d. Left mandible, $\times 16$.
 Fig. 1e. Right mandible, $\times 16$.
 Fig. 1f. Maxilla, $\times 20$.
 Fig. 1g. Labium, under view, $\times 20$.

- Fig. 1h. Labium, upper view, $\times 20$.
 Fig. 1i. Hypopharynx, $\times 40$.
 Fig. 1j. Right 1st leg, $\times 8$.
 Fig. 1k. Right 2nd leg, $\times 8$.
 Fig. 1l. Right 3rd leg, $\times 8$.
 Fig. 1m. Right 2nd gill lamella, $\times 12$.
 Fig. 1n. Right 1st gill lamella, $\times 20$.

Plate IV.

Potamanthus luteus.

- Fig. 2. Nymph, dorsal view, $\times 9$.
 Fig. 2a. Right antenna, $\times 20$.
 Fig. 2b. Labrum, $\times 25$.
 Fig. 2c. }
 Fig. 2d. } Mandibles, $\times 25$.
 Fig. 2e. Left maxilla, $\times 25$.

- Fig. 2f. Labium, under view, $\times 25$.
 Fig. 2g. Hypopharynx, $\times 25$.
 Fig. 2h. Right 1st leg, $\times 12$.
 Fig. 2i. Gill lamella of 2nd segment, (left),
 $\times 20$.

Rhithrogena japonica.

- Fig. 3. Nymph, dorsal view, $\times 9$.
 Fig. 3a. Right antenna, $\times 20$.
 Fig. 3b. Labrum, $\times 40$.

- Fig. 3c. }
 Fig. 3d. } Mandibles, $\times 40$.
 Fig. 3e. Maxilla, $\times 20$.
 Fig. 3f. Labium, $\times 16$.

Plate V.

Rhithrogena japonica.

- Fig. 3g. Hypopharynx, $\times 20$.
 Fig. 3h. Right 2nd leg, $\times 12$. (claw, $\times 50$)
 Fig. 3i. Nymph, ventral view, $\times 9$.
 Fig. 3j. Left 1st gill lamella, $\times 16$.

- Fig. 3k. Left 2nd gill lamella, $\times 16$.
 Fig. 3l. Right 3rd gill lamella, $\times 16$.
 Fig. 3m. Left 6th gill lamella, $\times 16$.
 Fig. 3n. Left 7th gill lamella, $\times 16$.

Iron sp.?

Fig. 4. Nymph, dorsal view, $\times 3$.

Fig. 4a. Head, dorsal view, $\times 8$.

Fig. 4b. Right antenna, $\times 20$.

Fig. 4c. Labrum, $\times 42$.

Fig. 4d. }
Fig. 4e. } Mandibles, $\times 20$.

Fig. 4f. Maxilla, $\times 20$.

Fig. 4g. Labium, $\times 16$.

Fig. 4h. Hypopharynx, $\times 20$.

Fig. 4i. Right 1st leg, $\times 8$; claw, $\times 50$.

Plate VI.

Iron sp.?

Fig. 4j. Nymph, ventral view, $\times 3$.

Fig. 4k. Left 1st gill lamella, $\times 12$.

Fig. 4l. Left 2nd gill lamella, $\times 16$.

Fig. 4m. Left 6th gill lamella, $\times 16$.

Fig. 4n. Left 7th gill lamella, $\times 16$.

Ecdyurus japonicus

Fig. 5. Nymph, dorsal view, $\times 2\frac{1}{2}$.

Fig. 5a. Right antenna, $\times 20$.

Fig. 5b. Labrum, $\times 16$.

Fig. 5c. Right mandible, $\times 20$.

Fig. 5d. Left mandible, $\times 20$.

Fig. 5e. Right maxilla, $\times 20$.

Fig. 5f. Labium, $\times 16$.

Fig. 5g. Hypopharynx, $\times 16$.

Fig. 5h. Right 1st leg, $\times 8$; claw, $\times 50$.

Fig. 5i. Claw of right 3rd leg, $\times 50$.

Fig. 5j. Right 1st gill lamella, $\times 20$.

Fig. 5k. Right 3rd gill lamella, $\times 20$.

Fig. 5l. Right 6th gill lamella, $\times 20$.

Fig. 5m. Right 7th gill lamella, $\times 20$.

Plate VII,

Epeorus latifolium.

Fig. 6. Nymph, dorsal view, $\times 4$.

Fig. 6a. Right antenna, $\times 20$.

Fig. 6b. Labrum, $\times 20$.

Fig. 6c. Right mandible, $\times 20$.

Fig. 6d. Left mandible, $\times 20$.

Fig. 6e. Left maxilla, $\times 20$.

Fig. 6f. Labium, under view, $\times 20$.

Fig. 6g. " , upper view, $\times 20$.

Fig. 6h. Hypopharynx, $\times 20$.

Fig. 6i. Right 1st leg, $\times 8$; claw, $\times 42$.

Fig. 6j. Right 2nd leg, $\times 8$.

Fig. 6k. Right 1st gill lamella, $\times 16$.

Fig. 6l. Right 3rd gill lamella, $\times 12$.

Fig. 6m. Right 6th gill lamella, $\times 12$.

Fig. 6n. Right 7th gill lamella, $\times 12$.

Fig. 6o. Posterior part of abdomen (gills removed), $\times 8$.

Plate VIII.

Paraleptophlebia cincta?

Fig. 7. Nymph, dorsal view, $\times 4$ (caudal setae broken off).

Fig. 7a. Right antenna, $\times 42$.

Fig. 7b. Labrum, $\times 20$.

Fig. 7c. Right mandible, $\times 20$.

Fig. 7d. Left mandible, $\times 20$.

Fig. 7e. Left maxilla, $\times 20$.

Fig. 7f. Labium, $\times 20$.

Fig. 7g. Hypopharynx, $\times 20$.

Fig. 7h. Right 1st leg, $\times 12$.

Fig. 7i. Left 1st gill lamella, $\times 20$.

Fig. 7j. Left 2nd gill lamella, $\times 20$.

Ephemerella longicaudata.

Fig. 8. Nymph, dorsal view, $\times 4$.

Fig. 8a. Left antenna, $\times 20$.

Fig. 8i. Gill lamella on 3rd segment, (right),
 $\times 12$.

Fig. 8j. Gill lamella on 4th segment,
 $\times 12$.

Fig. 8k. Gill lamella on 7th segment,
 $\times 12$.

Fig. 8l. Right 1st leg, $\times 12$.

Plate IX.

Ephemerella longicaudata.

Fig. 8b. Labrum, $\times 20$.

Fig. 8c. } Mandibles, $\times 20$.

Fig. 8d. }

Fig. 8e. } Maxilla, $\times 20$.

Fig. 8f. }

Fig. 8g. Labium, $\times 20$.

Fig. 8h. Hypopharynx, $\times 20$.

Ephemerella nigra.

Fig. 9. Nymph, dorsal view, $\times 4$.

Fig. 9a. Right antenna, $\times 20$.

Fig. 9b. Labrum, $\times 25$.

Fig. 9c. } Mandibles, $\times 25$.

Fig. 9d. }

Fig. 9e. Maxilla, $\times 25$.

Fig. 9f. Labium, $\times 25$.

Fig. 9g. Hypopharynx, $\times 25$.

Fig. 9h. Right 1st leg, $\times 12$; claw, $\times 42$.

Fig. 9i. Claw of right 3rd leg, $\times 42$.

Fig. 9j. Abdomen, dorsal view, $\times 5$. (right gill lamellae removed).

Fig. 9k. Left gill lamella on 3rd segment,
 $\times 25$.

Fig. 9l. Left gill lamella on 6th segment,
 $\times 25$.

Fig. 9m. Left gill lamella on 7th segment,
 $\times 25$.

Fig. 9n. A part of caudal seta, $\times 42$.

Plate X.

Ephemerella tuberculata?

Fig. 10. Head and fore-leg, $\times 8$.

Fig. 10a. Claw of right 1st leg, $\times 42$.

Ephemerella trispina.

Fig. 11. Nymph, dorsal view, $\times 5$.

Fig. 11a. Head, dorsal view, $\times 8$.

Fig. 11b. Right antenna, $\times 20$.

Fig. 11c. Labrum, $\times 42$.

Fig. 11d. } Mandibles, $\times 42$.

Fig. 11e. }

Fig. 11f. Maxilla, $\times 42$.

Fig. 11g. Labium, $\times 42$.

Fig. 11h. Hypopharynx, $\times 42$.

Fig. 11i. Right 1st leg, $\times 8$; claw, $\times 20$.

Fig. 11j. Right 2nd leg, $\times 8$.

Fig. 11k. Left gill lamella on 4th segment,
 $\times 25$.

Fig. 11l. Left gill lamella on 5th segment,
 $\times 25$.

Fig. 11m. Left gill lamella on 6th segment,
 $\times 25$.

Fig. 11n. Left gill lamella on 7th segment,
 $\times 25$.

Plate XI.

Cloëon dipterum

Fig. 12. Nymph, dorsal view, $\times 4$.

Fig. 12a. Head, frontal view, $\times 12$.

Fig. 12b. Antenna, $\times 12$; distal part,
 $\times 25$.

Fig. 12c. Labrum, $\times 25$.

Fig. 12d. } Mandibles, $\times 25$.

Fig. 12e. }

Fig. 12f. Maxilla, $\times 25$.

Fig. 12g. Labium, $\times 50$.

Fig. 12h. Hypopharynx, $\times 50$.

Fig. 12i. Right 1st leg, $\times 12$.

Fig. 12j. Left 1st gill lamella, $\times 20$.

Fig. 12k. Left 2nd gill lamella, $\times 20$.

Fig. 12l. Left 3rd gill lamella, $\times 20$.

Fig. 12m. Left 4th gill lamella, $\times 20$.

Fig. 12n. Left 6th gill lamella, $\times 20$.

Fig. 12o. Left 7th gill lamella, $\times 20$.

Fig. 12p. Hindmost segment and basal parts
of caudal setae, $\times 20$.

Plate XII.

Baëtis bioculatus.

Fig. 13. Nymph, dorsal view, $\times 6$.

Fig. 13a. Right antenna, $\times 12$.

Fig. 13b. Labrum, $\times 42$,

Fig. 13c. Mandible, $\times 42$.

Fig. 13d. Maxilla, $\times 42$.

Fig. 13e. Labium, $\times 42$.

- Fig. 13f. Hypopharynx, $\times 42$.
 Fig. 13g. Left 1st leg, $\times 12$; claw, $\times 20$.
 Fig. 13h. Left 1st gill lamella, $\times 20$.
 Fig. 13i. Left 2nd gill lamella, $\times 20$.
 Fig. 13j. Left 3rd gill lamella, $\times 20$.

- Fig. 13k. Left 4th gill lamella, $\times 20$.
 Fig. 13l. Left 5th gill lamella, $\times 20$.
 Fig. 13m. Left 6th gill lamella, $\times 20$.
 Fig. 13n. Left 7th gill lamella, $\times 20$.

Plate XIII.

Chirotanetes japonicus ?

- Fig. 14. Nymph, dorsal view (left 5th–7th gill lamellae removed), $\times 4$.
 Fig. 14a. Anterior part of body, lateral view, $\times 4$.
 Fig. 14b. Left antenna, $\times 20$.
 Fig. 14c. Labrum, $\times 20$.
 Fig. 14d. } Mandibles, $\times 20$.
 Fig. 14e. }
 Fig. 14f. Maxilla, $\times 20$.
 Fig. 14g. Labium, $\times 20$.

- Fig. 14h. Hypopharynx, $\times 20$.
 Fig. 14i. Left 1st leg, $\times 16$.
 Fig. 14j. Right 2nd leg, $\times 16$.
 Fig. 14k. Abdominal segments VII, VIII, and IX, lateral view, $\times 8$.
 Fig. 14l. Right 1st gill, $\times 20$.
 Fig. 14m. Right 2nd gill, $\times 20$.
 Fig. 14n. Right 3rd gill, $\times 20$.
 Fig. 14o. Right 7th gill, $\times 20$.

Plate XIV.

Siphonurus alternatus ?

- Fig. 15. Nymph, dorsal view, $\times 3$.
 Fig. 15a. Right antenna, $\times 20$.
 Fig. 15b. Labrum, $\times 20$.
 Fig. 15c. } Mandibles,
 Fig. 15d. }
 Fig. 15e. Maxilla, $\times 20$.
 Fig. 15f. Labium, $\times 20$.

- Fig. 15g. Hypopharynx, $\times 20$.
 Fig. 15h. Right 1st leg, $\times 12$.
 Fig. 15i. Left 1st gill lamella, $\times 16$.
 Fig. 15j. Left 2nd gill lamella, $\times 20$.
 Fig. 15k. Left 4th gill lamella, $\times 16$.
 Fig. 15l. Right 7th gill lamella, $\times 16$.

Plate XV.

Choroterpes trifurcata.

- Fig. 16. Nymph, dorsal view, $\times 18$.
 Fig. 16a. Labrum, $\times 55$.
 Fig. 16b. Maxilla, $\times 55$.

- Fig. 16c. } Mandibles, $\times 55$.
 Fig. 16d. }
 Fig. 16e. Labium, $\times 55$.

Fig. 16f. Left 3rd leg, $\times 26$.

Fig. 16g. Claw, $\times 170$.

Fig. 16h. Right 1st gill lamella, $\times 55$.

Fig. 16i. Left 2nd gill lamella, $\times 55$.

Fig. 16j. Left 5th gill lamella, $\times 55$.

Plate XVI.

Caenis sp.

Fig. 17. Nymph, dorsal view, $\times 18$.

Fig. 17a. Head, dorsal view, $\times 26$.

Fig. 17b. Antenna, $\times 55$.

Fig. 17c. Labrum, $\times 110$.

Fig. 17d. Mandible, $\times 110$.

Fig. 17e. Maxilla, $\times 110$.

Fig. 17f. Labium, $\times 110$.

Fig. 17g. Hypopharynx, $\times 110$.

Fig. 17h. Abdomen, dorsal view; right gill lamellae removed, $\times 26$.

Fig. 17i. Left 1st gill, $\times 80$.

Fig. 17j. Right 2nd elyteroid gill cover, dorsal view, $\times 55$.

Fig. 17k. Right 3rd gill, $\times 80$.

Fig. 17l. Right 4th gill, $\times 80$.

Fig. 17m. Right 1st leg, $\times 55$.

Plate XVII.

? *Acentrella* sp.

Fig. 18a. Head, dorsal view, $\times 18$.

Fig. 18b. Labrum, $\times 80$.

Fig. 18c. Maxilla, $\times 80$.

Fig. 18d. }

Fig. 18e. } Mandibles, $\times 80$.

Fig. 18f. Labium, $\times 80$.

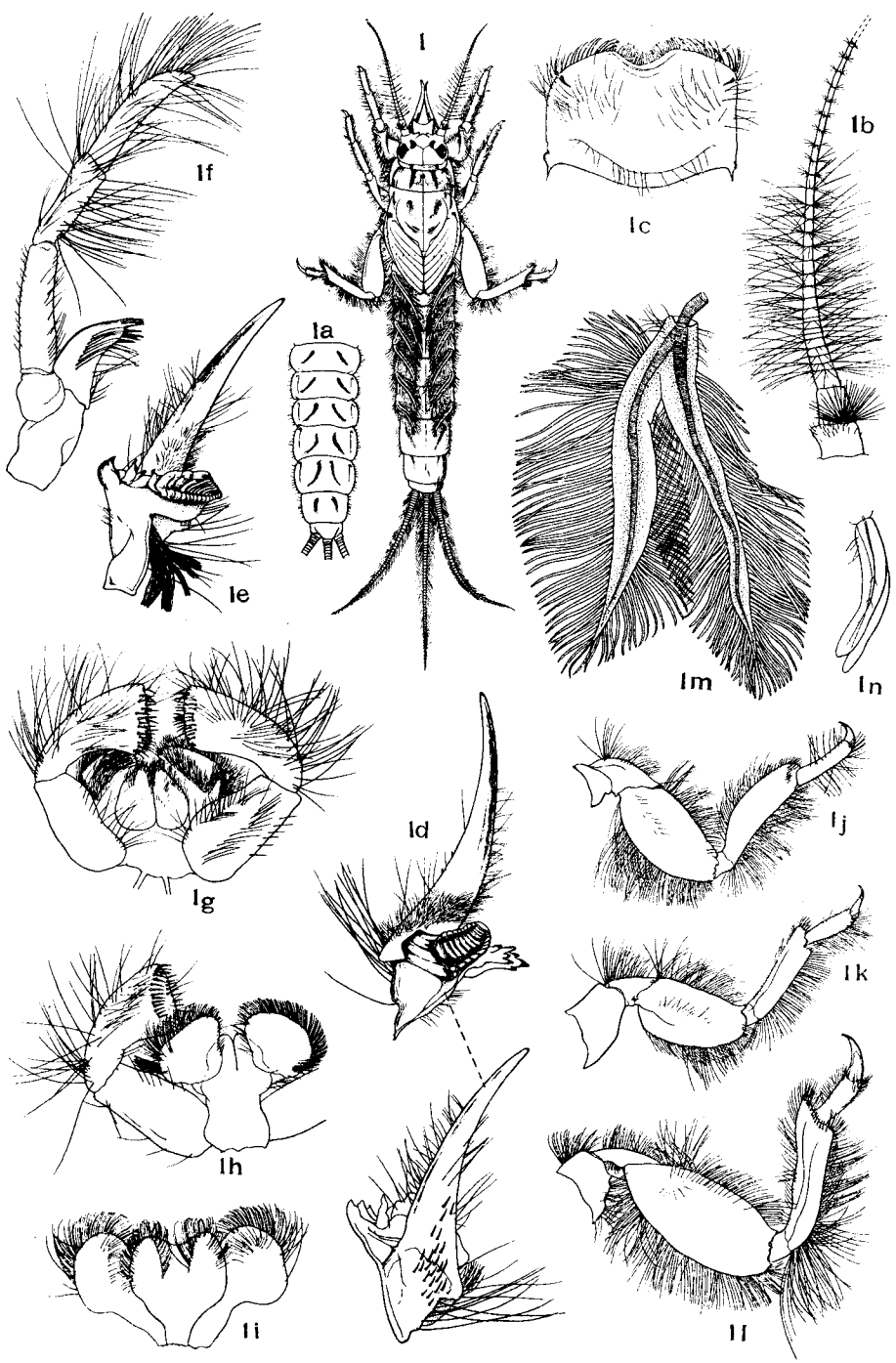
Fig. 18g. Abdomen, dorsal view, $\times 18$.

Fig. 18h. Abdomen, ventral view, $\times 18$.

Fig. 18i. Right 4th gill lamella, $\times 80$.

Fig. 18j. Right 1st gill lamella, $\times 80$.

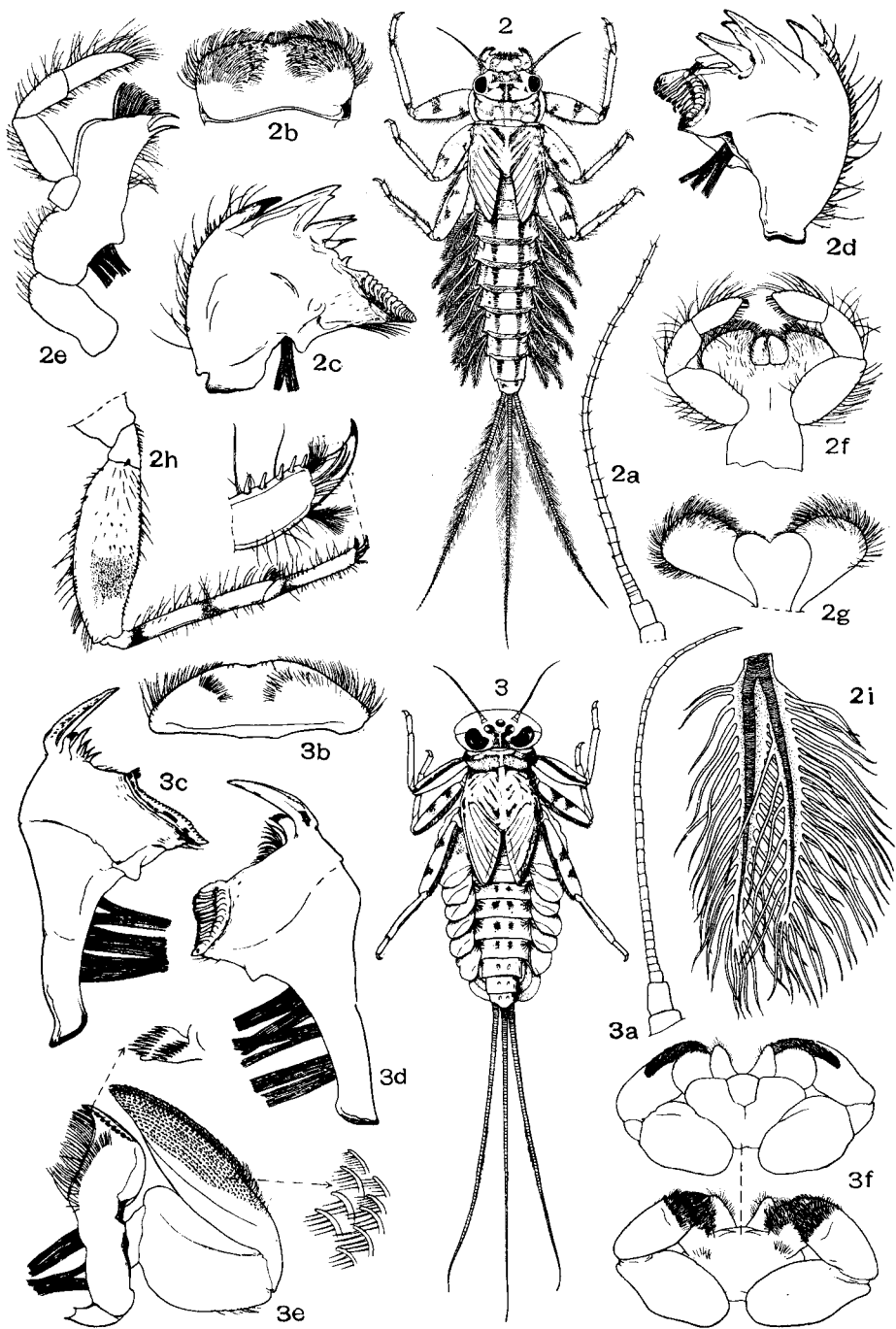
Fig. 18k. Right 1st leg, $\times 18$; claw, $\times 170$.



M. UÉNO delin.

UÉNO : Japanese Mayfly Nymphs.

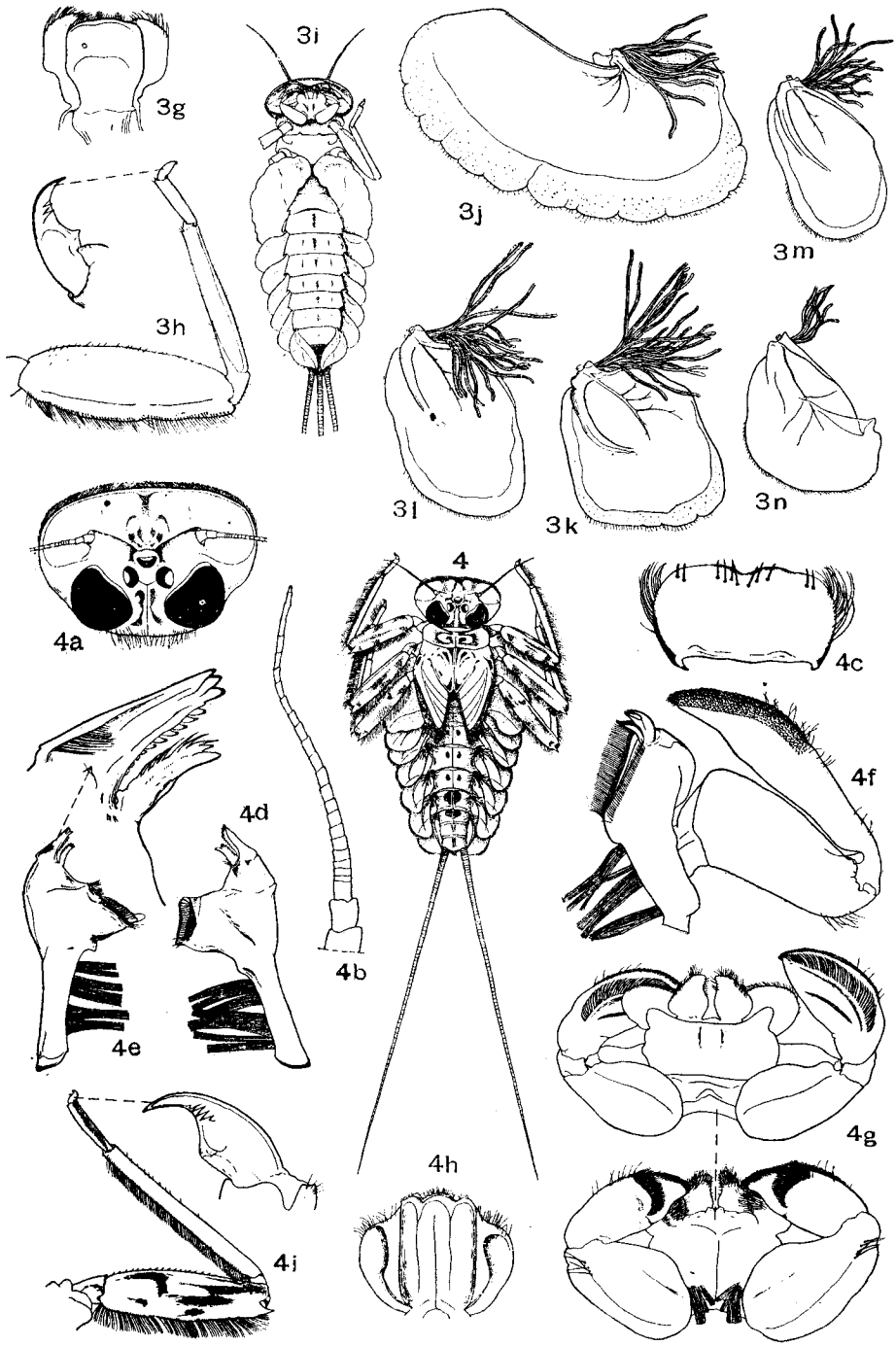
Ephemerida (?)*japonica*.



M. UÉNO delin.

UÉNO : Japanese Mayfly Nymphs.

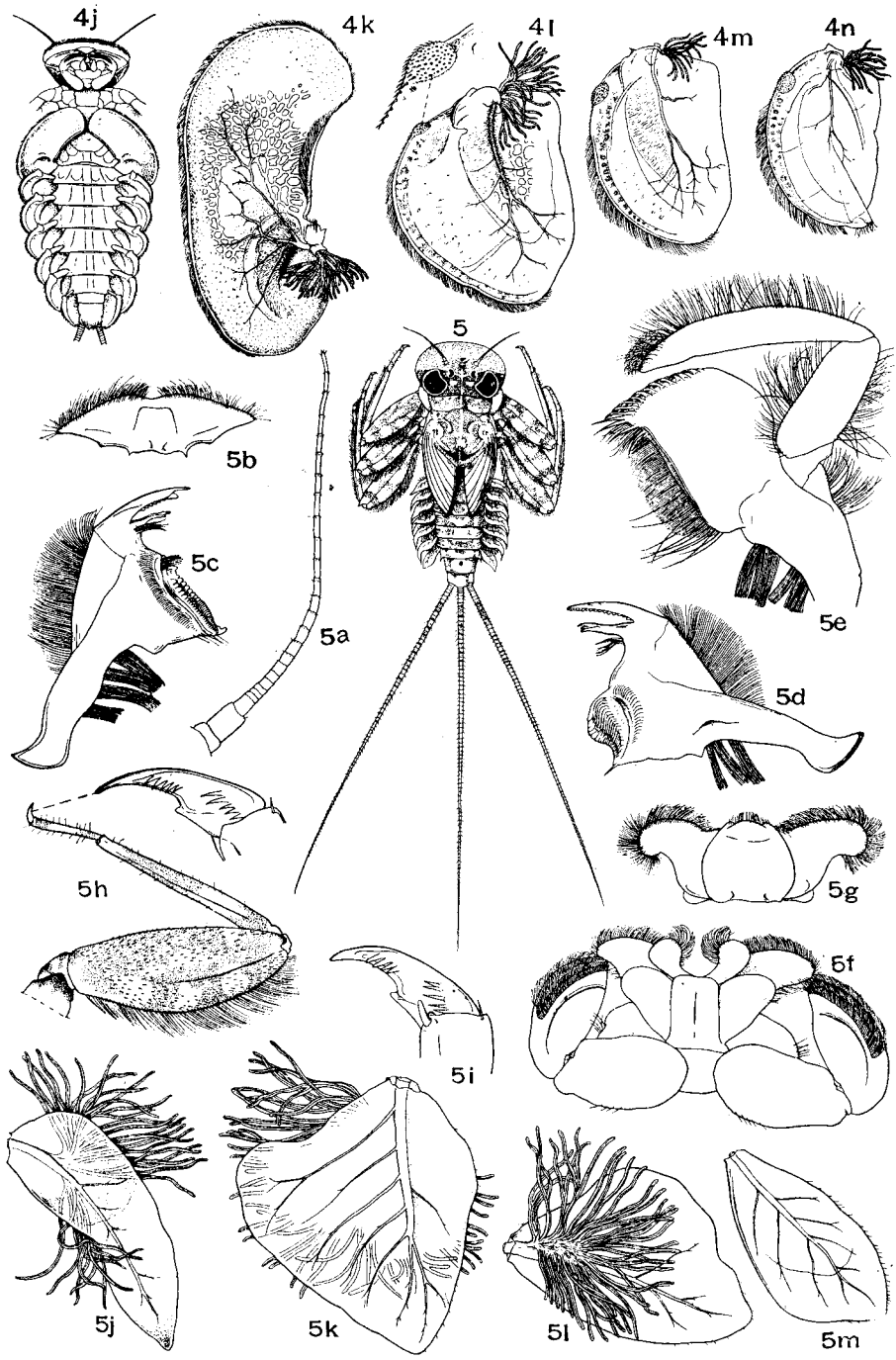
2, 2a-2i. *Potamanthus luteus*; 3, 3a-3f. *Rhithrogena japonica*.



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

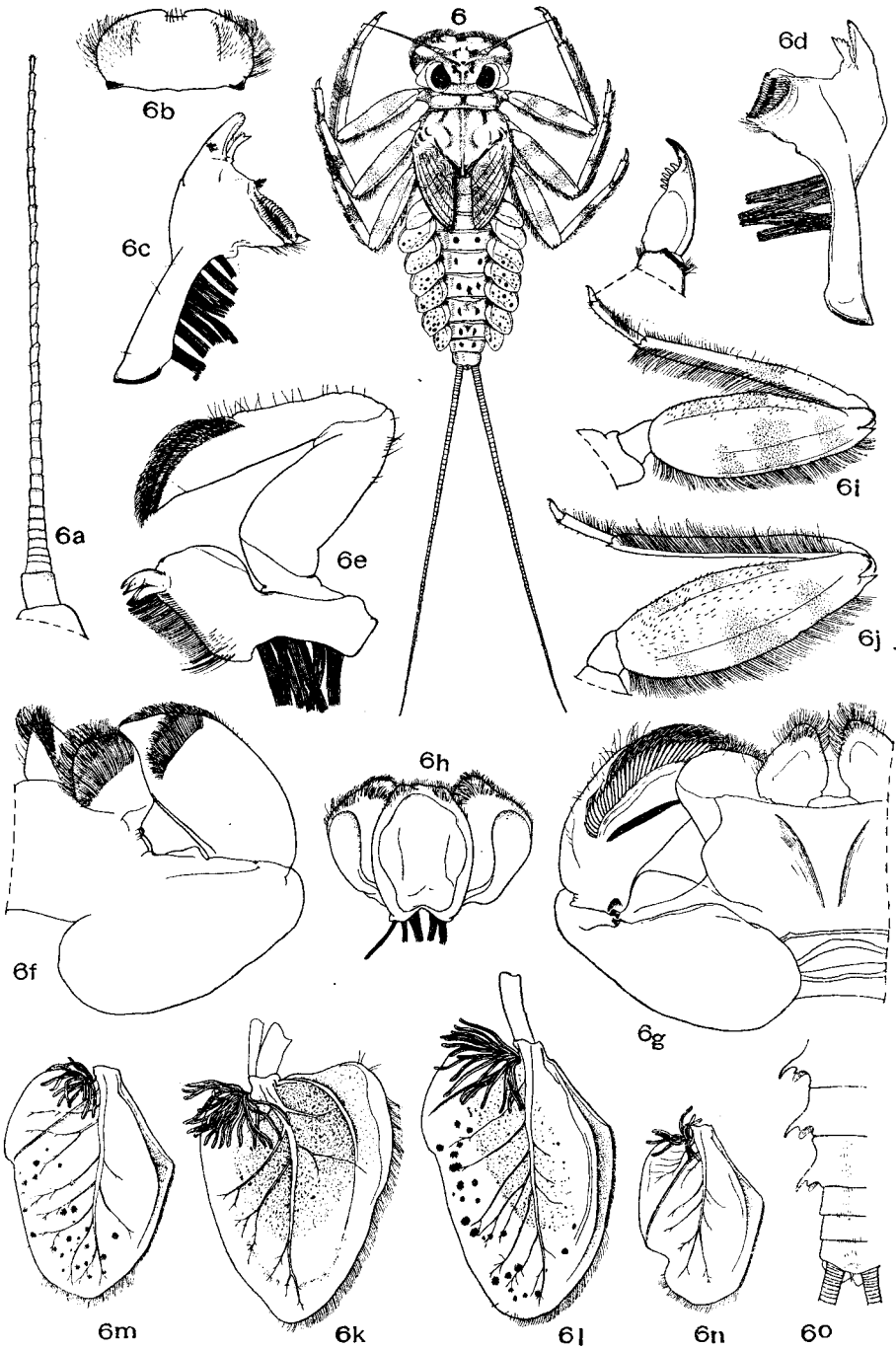
3g—3n. *Rhithrogena japonica*; 4, 4a—4i. *Iron* sp.?



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

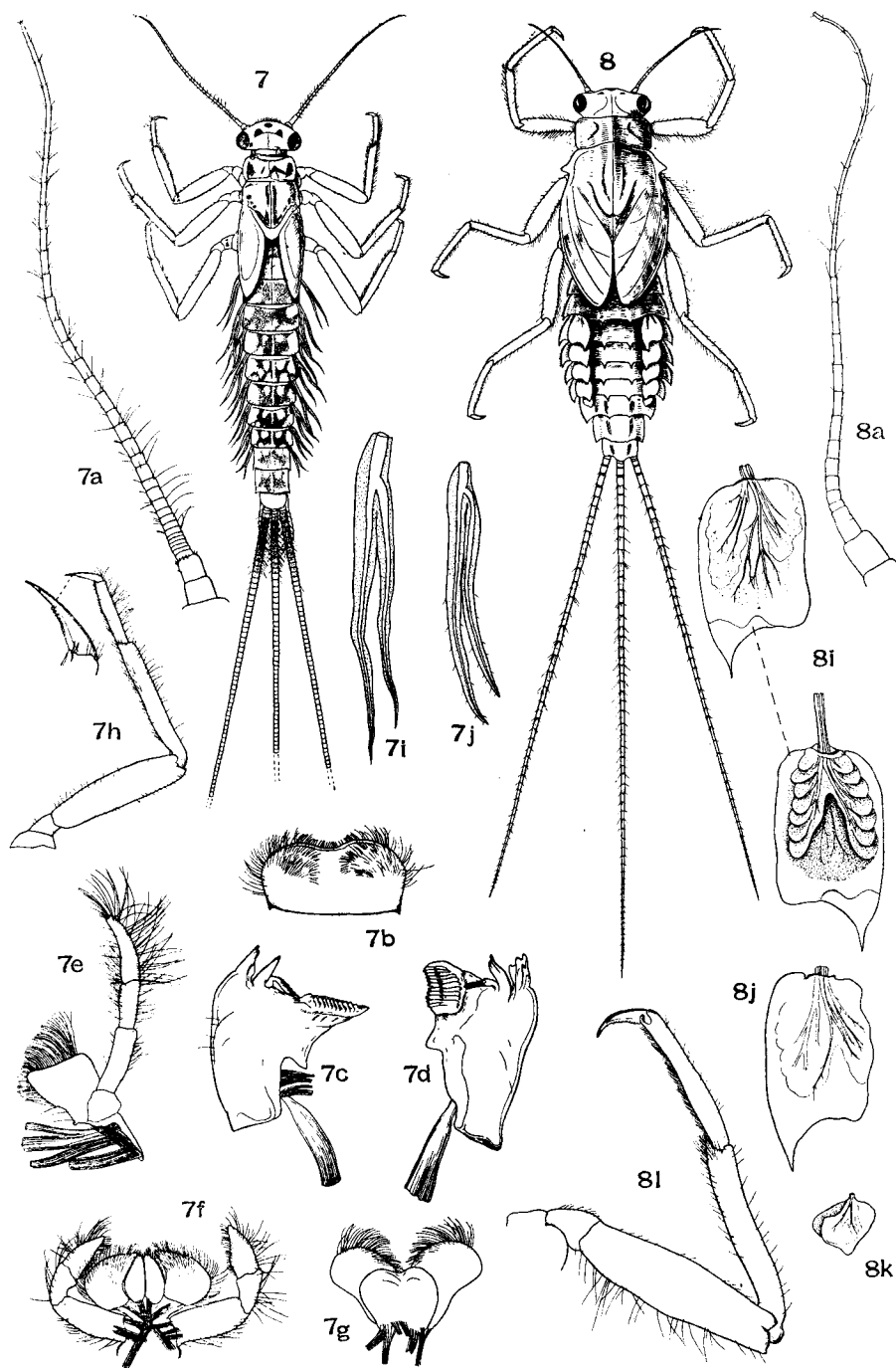
4j—4n. *Iron* sp. ? ; 5. 5a—5m. *Ecdyurus japonicus*.



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

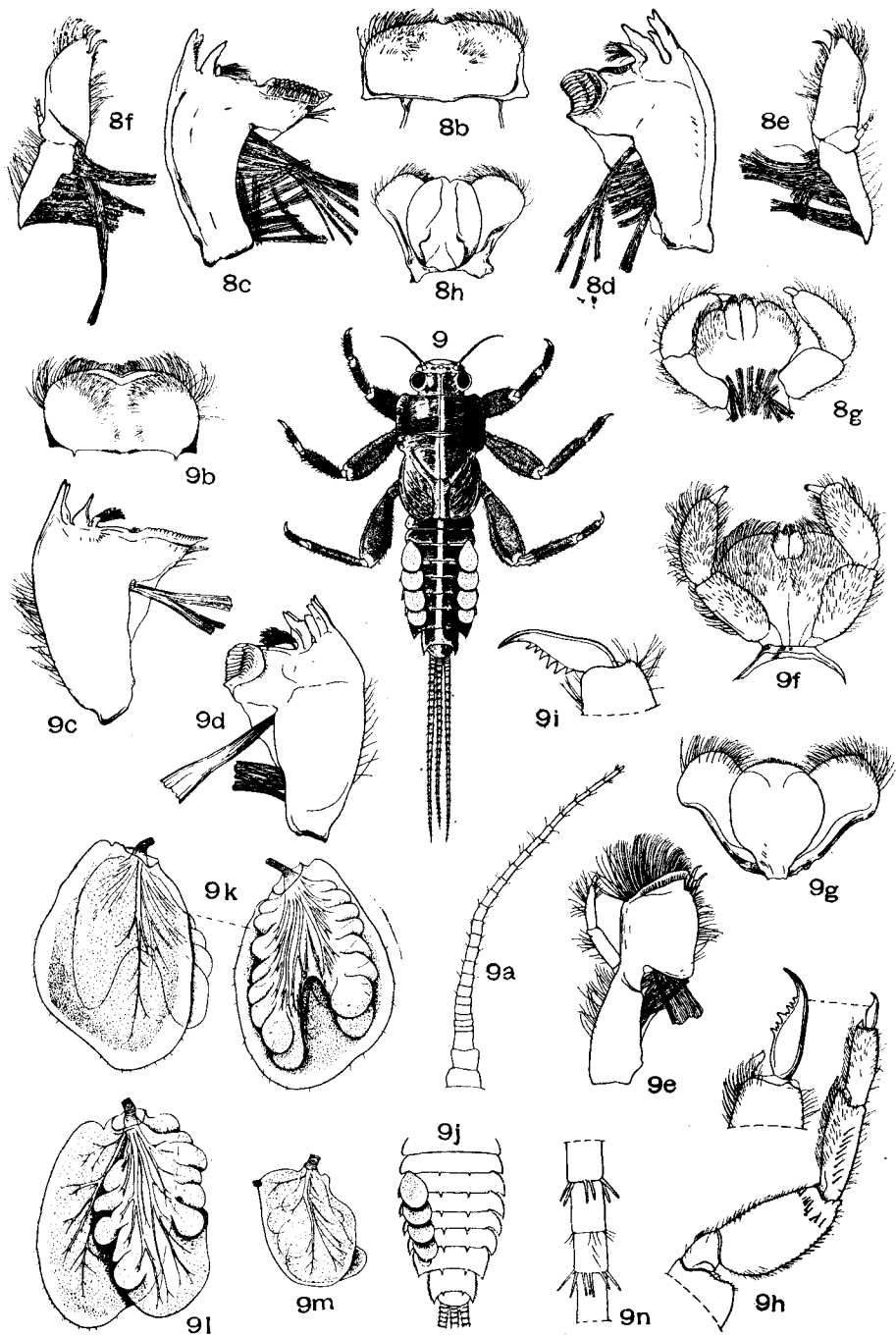
Epcorus latifolium.



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

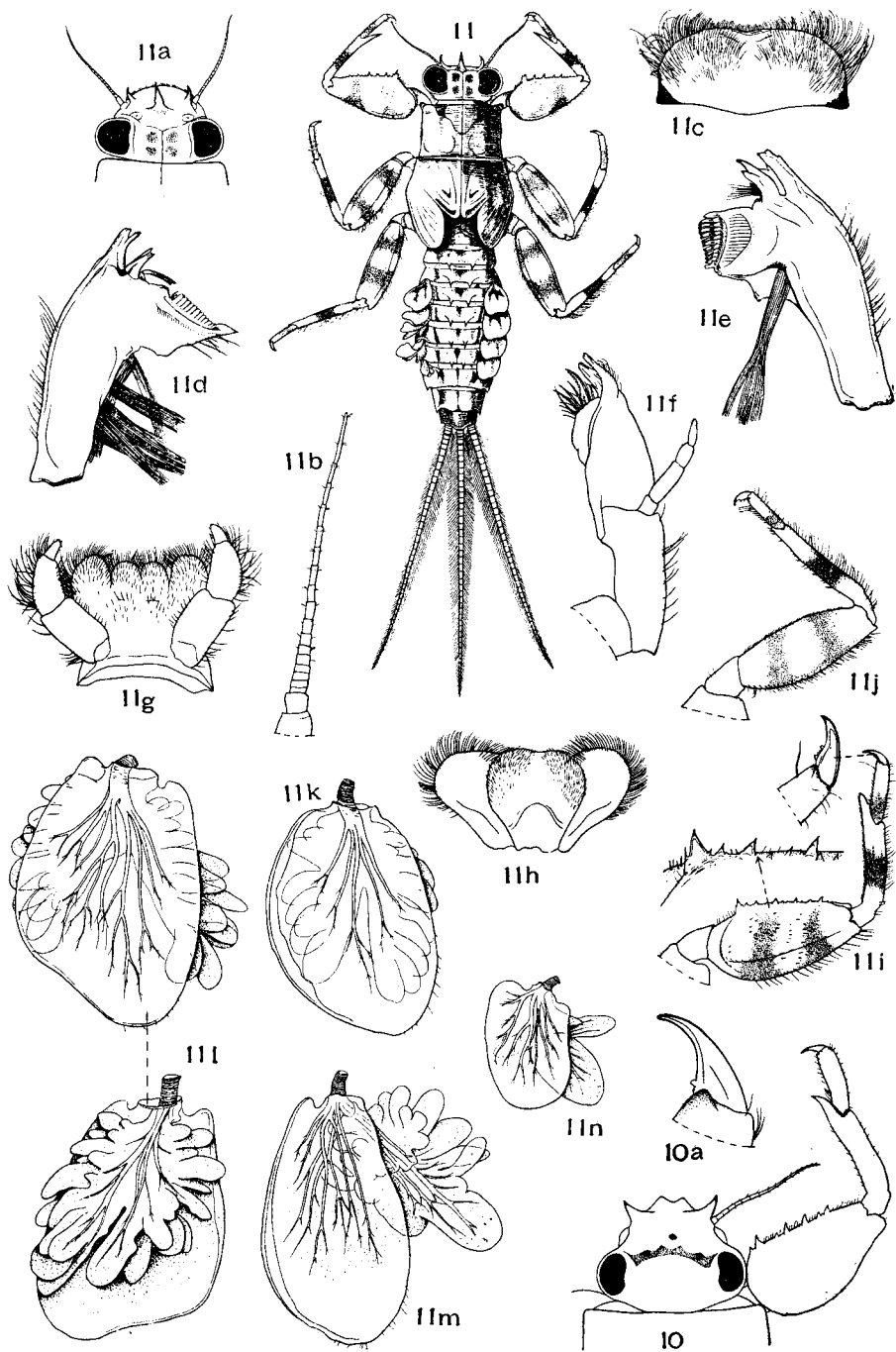
7, 7a—7j. *Paraleptophlebia cincta*?; 8, 8a, 8i—8l. *Ephemerella longicaudata*.



M. UENO delin.

UENO : Japanese Mayfly Nymphs.

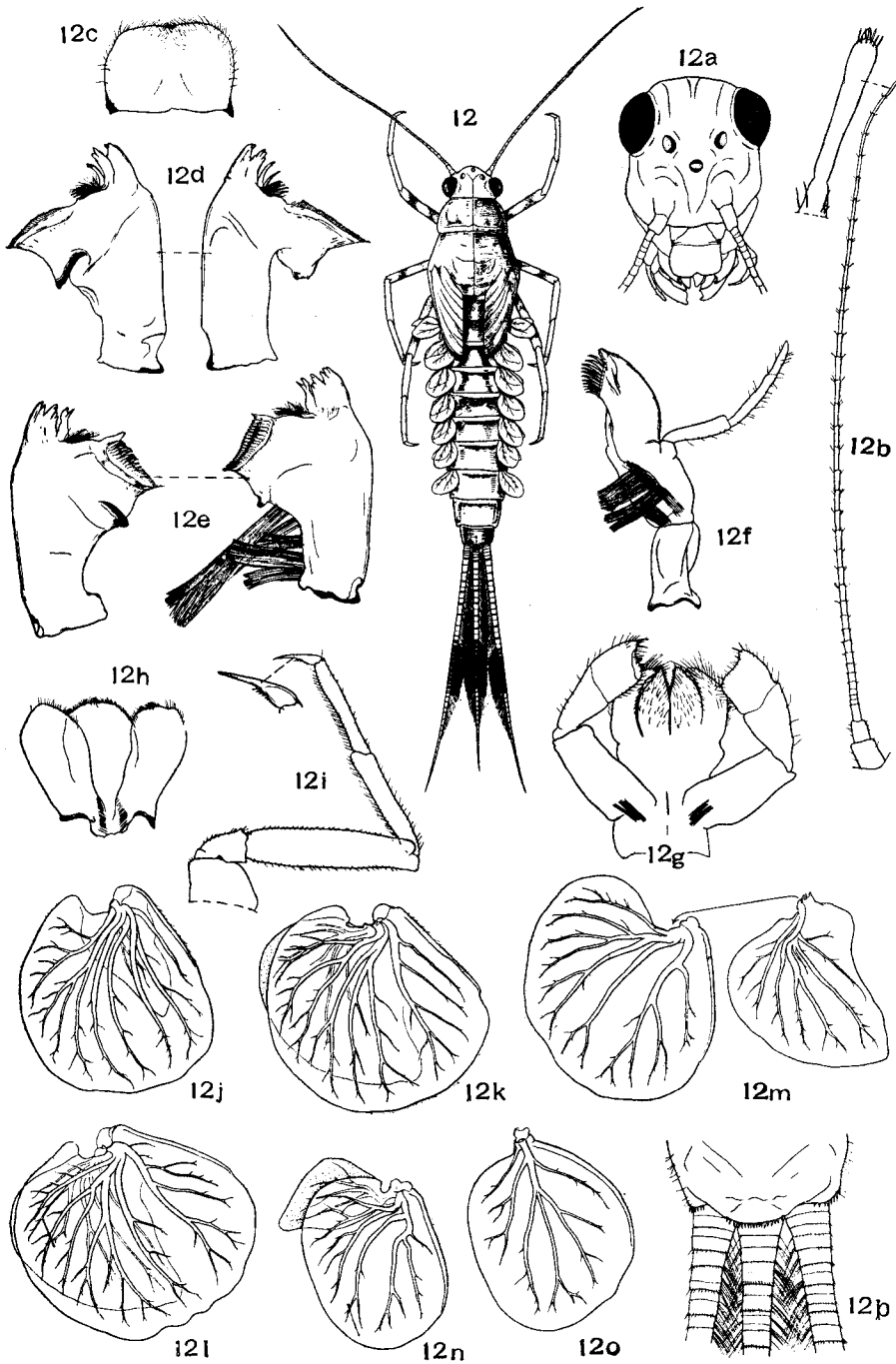
8c--8h. *Ephemerella longicaudata* ; 9, 9a--9n. *Ephemerella nigra* :



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

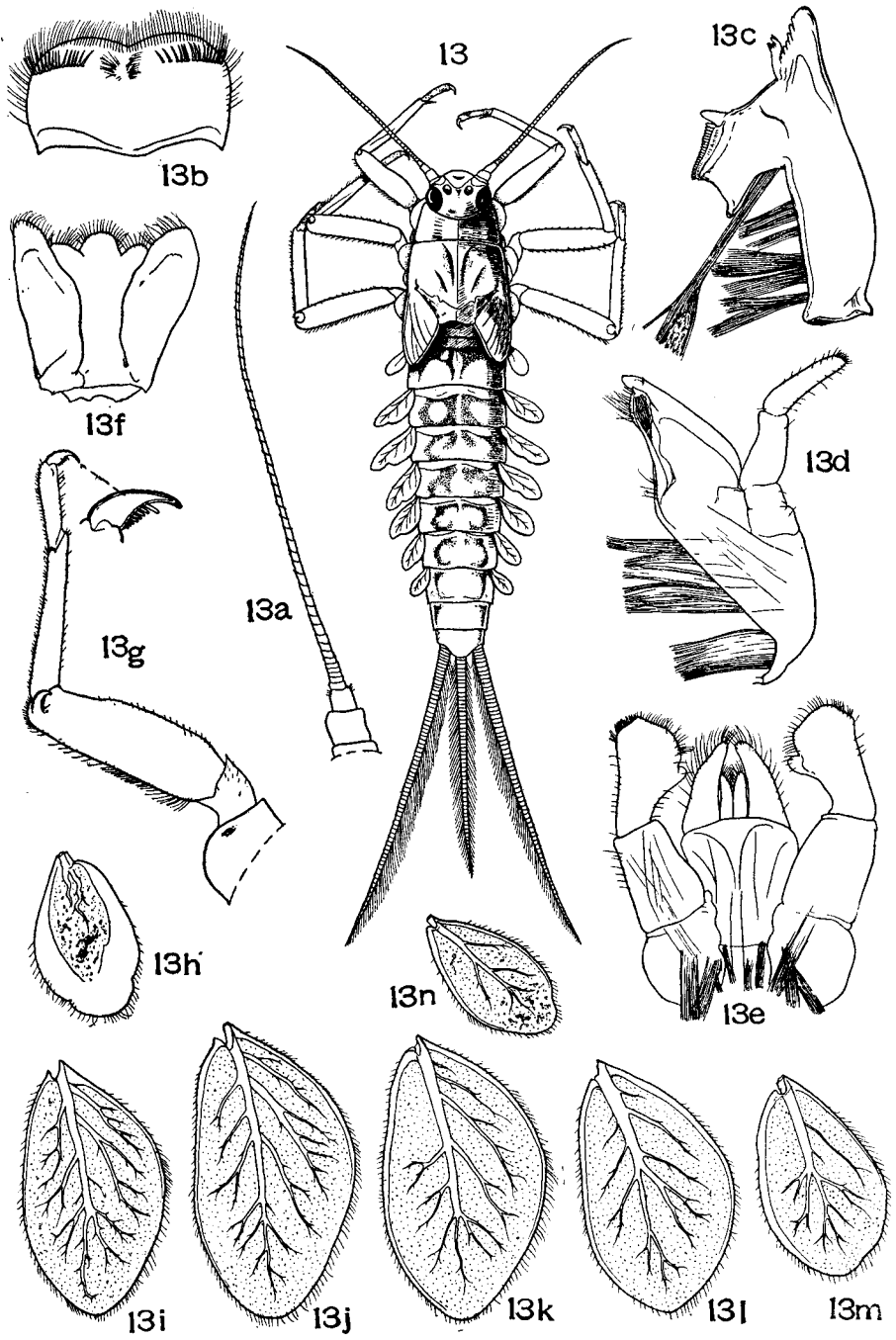
10, 10a. *Ephemerella tuberculata* ?; 11, 11a—11n. *Ephemerella tristipina*.



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UÉNO : Japanese Mayfly Nymphs.

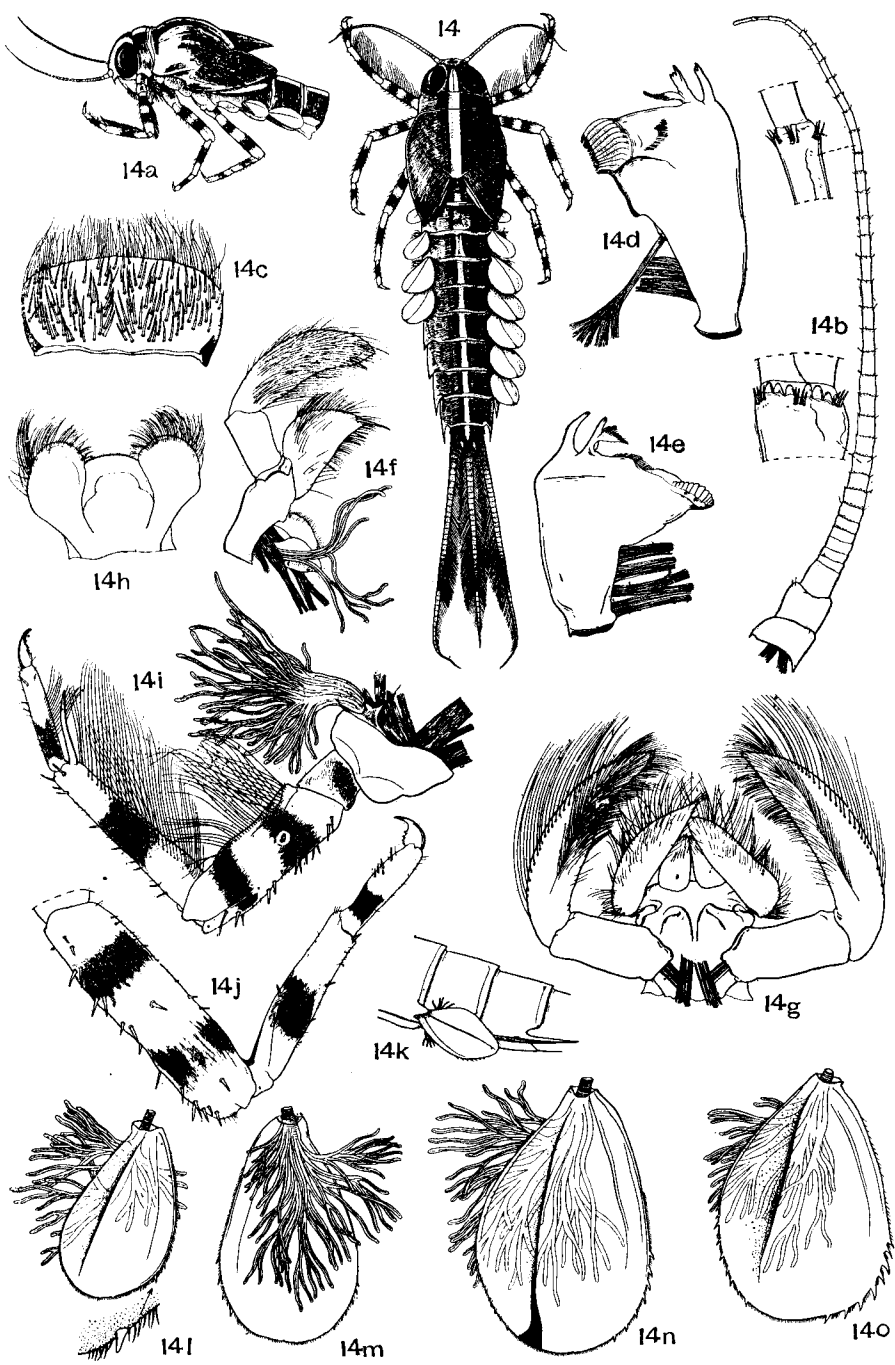
Cloëon dipterum.



M. UÉNO delin.

UÉNO : Japanese Mayfly Nymphs.

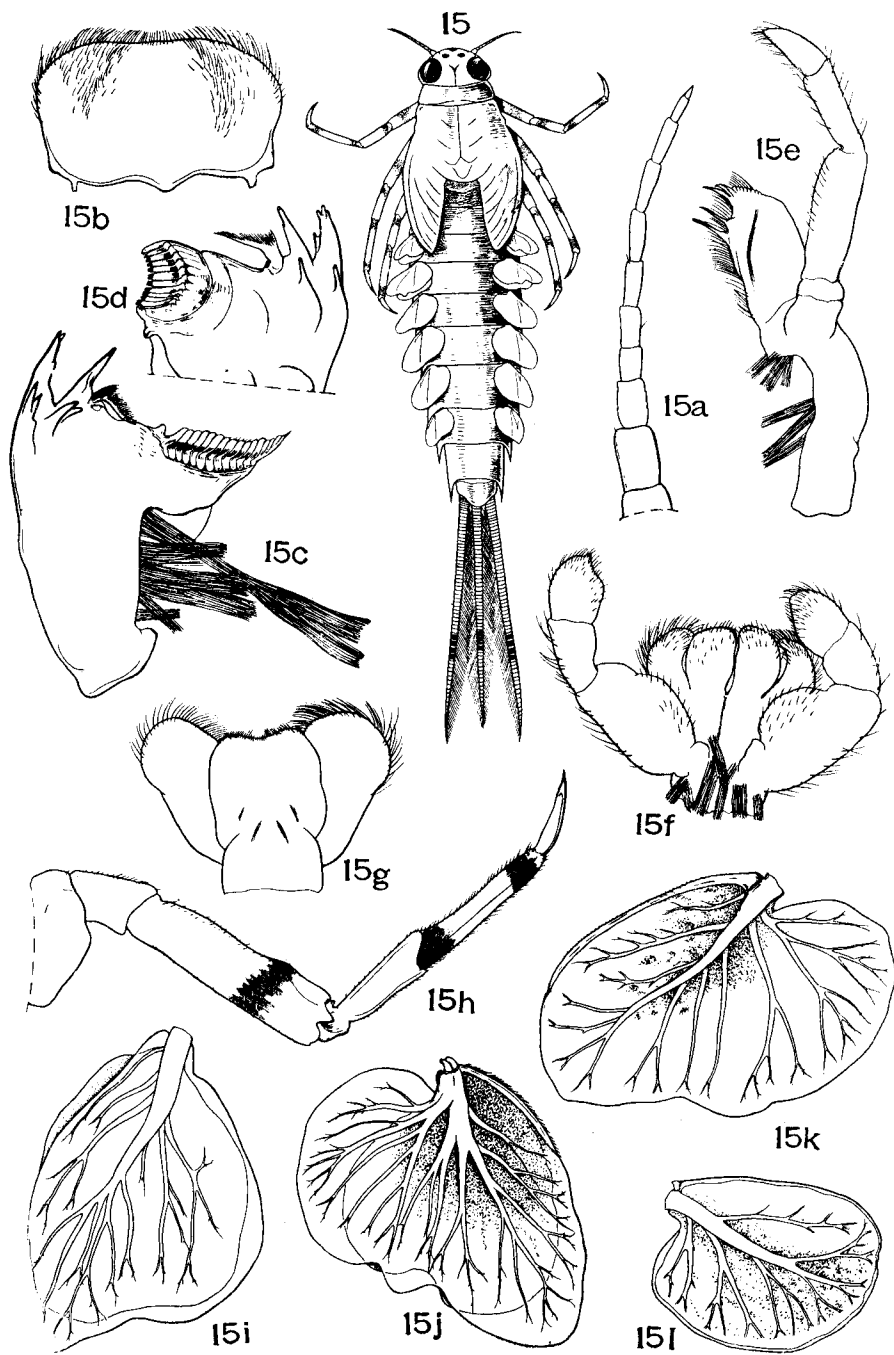
Baëtis bioculatus.



M. UENO deli..

UENO: Japanese Mayfly Nymphs.

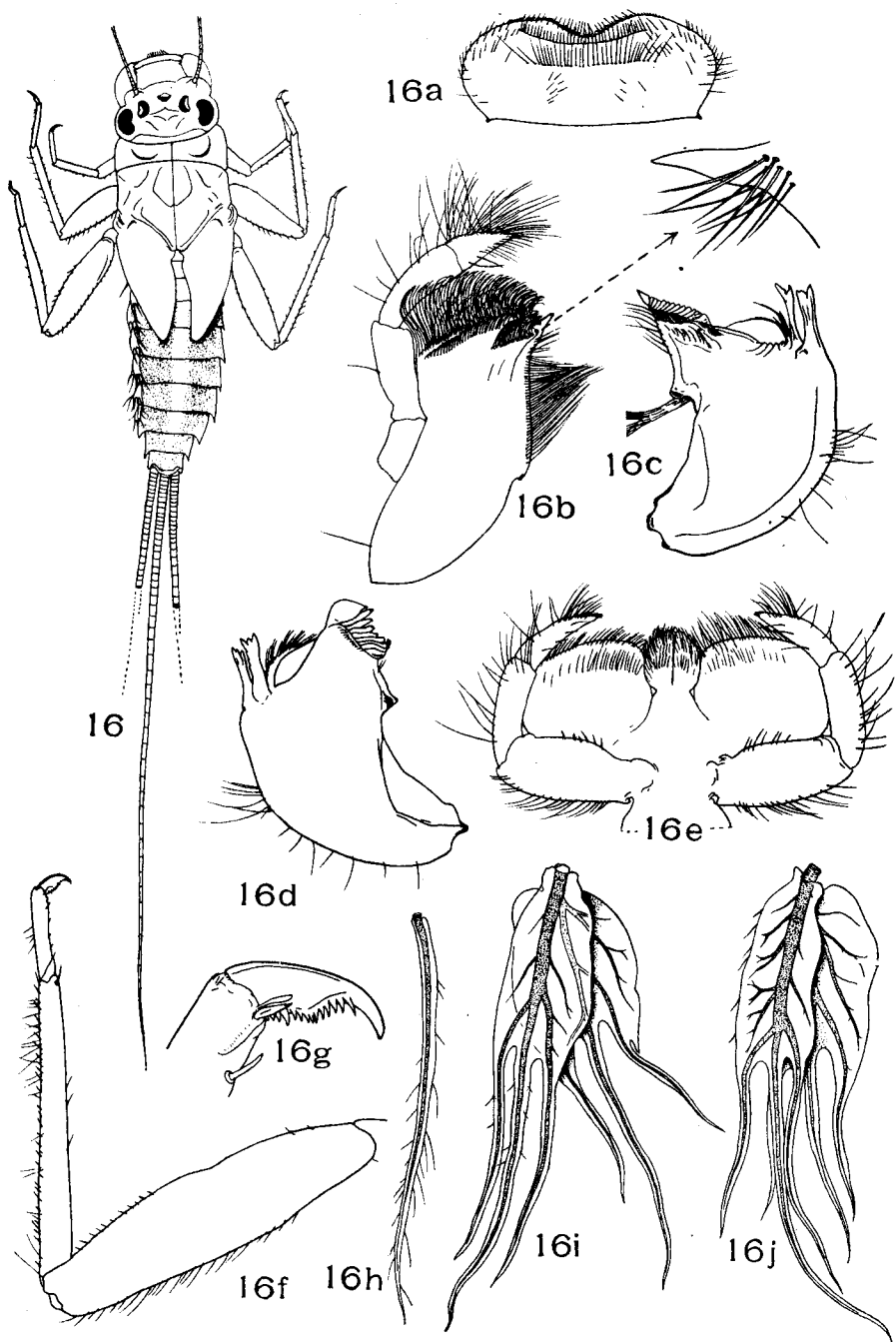
Chironectes japonicus?



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

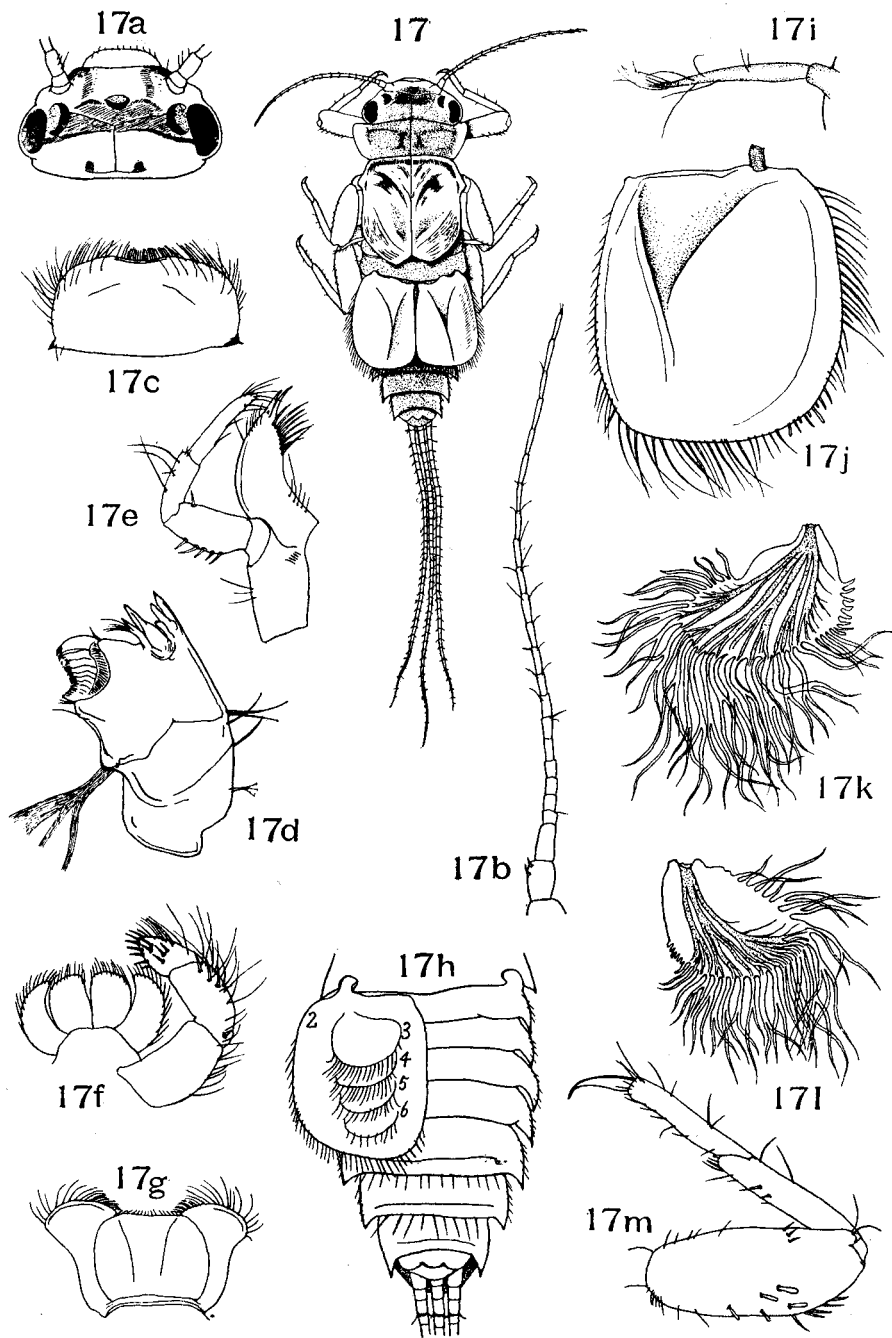
Siphurinus alternatus?



M. UÉNO delin.

UÉNO: Japanese Mayfly Nymphs.

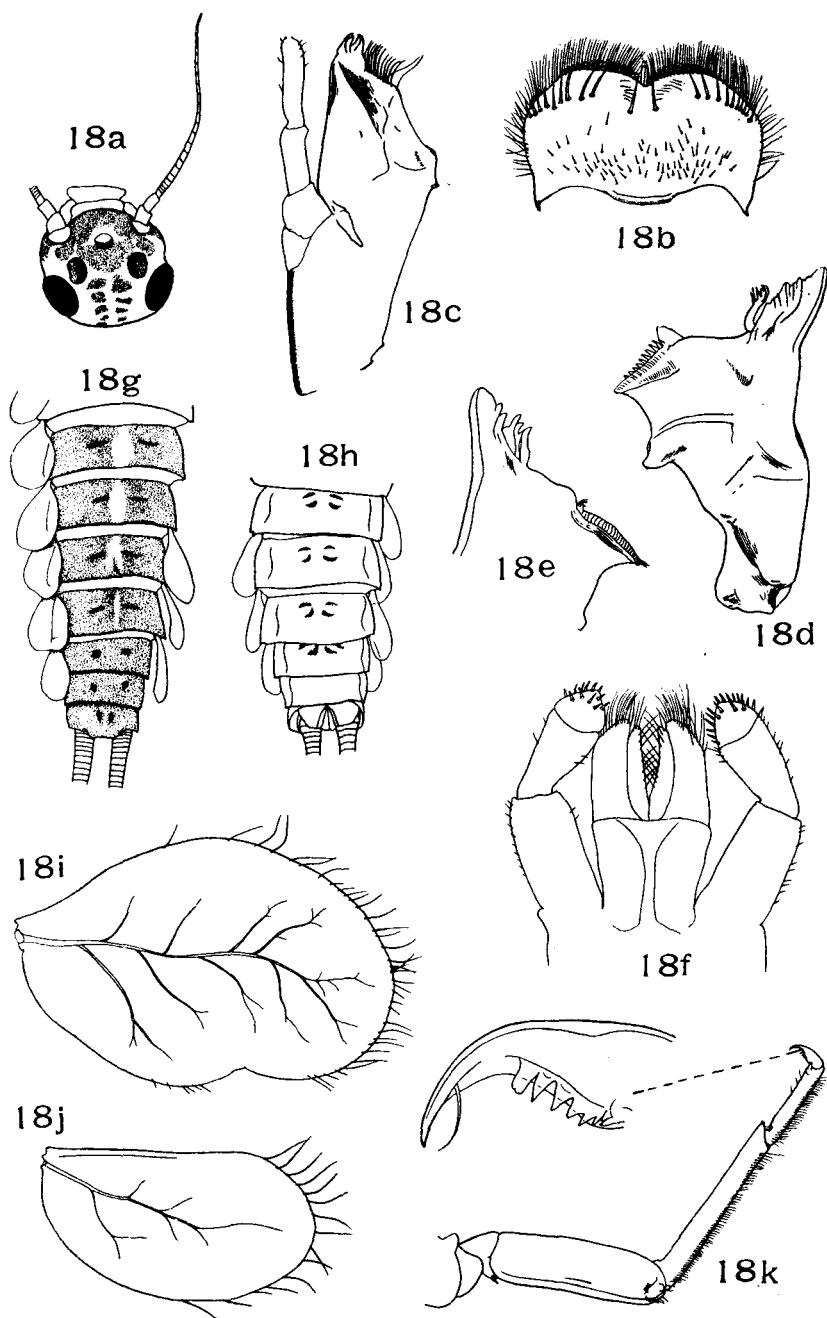
Choroterpes trifurcata.



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

Caenis sp.



M. UENO delin.

UENO: Japanese Mayfly Nymphs.

? *Acentrella* (n. sp.?).